NIST Special Publication 500-xxx

ANSI/NIST-ITL 1-2011

*Information Technology:*

American National Standard for Information Systems

Data Format for the Interchange of Fingerprint, Facial
& Other Biometric Information



Approved American National Standard

(ANSI)

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

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# Foreword

## This foreword is not part of the American National Standard

## ANSI/NIST-ITL 1-2011

Law enforcement and related criminal justice agencies as well as identity management organizations procure equipment and systems intended to facilitate the determination of the personal identity of a subject or verify the identity of a subject using biometric information. To effectively exchange identity data across jurisdictional lines or between dissimilar systems made by different manufacturers, a standard is needed to specify a common format for the data exchange.

Biometric data refers to a digital or analog representation of a behavioral or physical characteristic of an individual that can be used by an automated system to distinguish an individual as belonging to a subgroup of the entire population or in many cases, can be used to uniquely establish or verify the identity of a person (compared to a claimed or referenced identity). Biometric modalities specifically included in this standard are: fingerprints, plantars (footprints), palmprints, facial images, DNA and iris images. Identifying characteristics that may be used manually to establish or verify the identity of an individual are included in the standard. This includes scars, marks, tattoos, and certain characteristics of facial photos and iris images. Latent friction ridge prints (fingerprint, palmprint and plantars) are included in this standard and may be used in either an automated system or forensically (or both).

Some data may be stored and/or transmitted in image or processed versions. The image may be 'raw' (as captured), compressed, cropped, or otherwise transformed. It is important, therefore that information associated with the image(s) be transmitted to the receiving organization that fully describes the biometric data. This standard also allows for the transmission of processed sample data, such as minutiae and other features from friction ridge biometrics.

The Information Technology Laboratory (ITL) of the National Institute of Standards and Technology (NIST) sponsored the development of this American National Standards Institute (ANSI) approved American National Standard using the NIST Canvass Method to demonstrate evidence of consensus. This updated standard replaces ANSI/NIST-ITL 1-2007 and ANSI/NIST-ITL 2-2008 standards and the amendment ANSI/NIST-ITL 1a-2009.

Send suggestions for the improvement of this standard to the attention of:

NIST, 100 Bureau Dr, Mail Stop 8940

Gaithersburg, MD 20899-8940.

# Introduction

Information compiled and formatted in accordance with this standard may be recorded using machine-readable media and may be transmitted by data communication facilities. Law enforcement, criminal justice agencies, and other organizations that process biometric data use the standard to exchange identity data such as images of fingerprints, palmprints, plantars, faces and other body parts including iris and scars, marks[1] and tattoos (SMT). The standard also allows the exchange of forensic markups of images of faces, irises, other body parts, and latent friction ridge prints.

The first version of this standard, *ANSI/NBS-ICST 1-1986*, was published by NIST (formerly the National Bureau of Standards) in 1986. It was a fingerprint minutiae-based standard. Revisions to the standard were made in 1993, 1997, 2000, and 2007. Updates to the standard are designed to be backward compatible, with new versions including additional information. All of these versions use "Traditional" encoding. In 2008, 'NIEM[2]-conformant encoding' using Extensible Markup Language (XML) was adopted. The 2007 and 2008 versions of the standard are equivalent (with some minor exceptions) except for the encoding format. In 2009 an amendment to the 2007 and 2008 versions was approved that extended encodings to handle multiple finger capture. The versions of the standard have been created with the concept of adding new material to previous versions and maintaining the integrity of the previous versions. This version of the standard does not restrict encoding to any particular format. However, in cases where an alternative encoding is used, the sending and receiving parties shall document encoding rules and assumptions.

This standard defines the structure of a <u>transaction</u>[3] that is transmitted to another site or agency. A transaction is comprised of <u>records</u>. Each Record Type is defined in this standard. However, certain portions of the transaction may be in accordance with definitions provided by the receiving agency, as described in the standard. The transaction shall contain records pertaining to a single subject. Biometric data used to identify another individual shall be contained in a separate transaction. However, some records (such as Record Type-18) may include biometric data from another person if that data is used to corroborate or establish the identity of the subject of the transaction.

This version of the standard is available in PDF format, which preserves internal cross-reference links. Such links are shown in green. External hyperlinks are shown in blue.

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[1] Marks, as used in this standard, means needle marks typical of drug use. The term 'marks' in some nations denotes what is called 'latent prints' in the terminology of this standard.

[2] NIEM, the National Information Exchange Model, is a partnership of the U.S. Department of Justice and Department of Homeland Security. It is designed to provide a common semantic approach in XML applications.

[3] An ANSI/NIST-ITL transaction is called a file in Traditional Encoding and an Exchange Package in XML encoding.

# 1 Scope

This standard defines the content, format, and units of measurement for the exchange of fingerprint, palmprint, plantar, facial/mugshot, scar mark & tattoo (SMT), iris, DNA[4], and other biometric sample and forensic information that may be used in the identification or verification process of a subject. The information consists of a variety of mandatory and optional items. This information is primarily intended for interchange among criminal justice administrations or organizations that rely on automated identification systems or use other biometric and image data for identification purposes.

# 2 Conformance to the standard

## 2.1 Verbal forms for the expression of provisions

The following terms are used in this document to indicate mandatory requirements, recommended options, or permissible actions:

- The terms "shall" and "shall not" indicate requirements strictly to be followed in order to conform to this standard and from which no deviation is permitted;
- The terms "should" and "should not" indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited;
- The terms "may" and "need not" indicate a course of action permissible within the limits of this document.

## 2.2 General

A system is conformant to this standard if it is capable of generating or using transactions that are syntactically and semantically compliant to the requirements of this standard. Transactions shall consist of one Type-1 record and one or more of the Type-2 to Type-99 records.

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[4] Deoxyribonucleic acid – essential for most forms of life.

## 2.3 Syntactic conformance

Transactions that claim syntactic conformance to this standard shall satisfy the syntactic requirements as described in Clauses 7 and 8 for each implemented record type. If the system claims conformance with a particular encoding, then it shall satisfy the syntactic requirements of either **Annex B Traditional encoding** or **Annex C NIEM-conformant encoding rules**, as appropriate.

Syntactic conformance is a test of syntax and format. Specifically syntactic conformance checks for:

- The structure of the transaction;

Field-by-field[5] and byte-by-byte conformance with the specification of the standard, that is if fields are included and the ranges of the values in the fields are according to specifications;

- If the values of the fields in a record are internally consistent; and,

- If the values of the fields in the record are consistent with the value of the fields in other records.

See **Table 4** for a list of the valid finger position codes, which is used in the following examples:

Example 1: A value of 10 for finger position code is syntactically conformant.
Example 2: A value of 167 for finger position code is not syntactically conformant.

## 2.4 Semantic conformance

Transactions that claim semantic conformance to this standard shall satisfy the semantic requirements as described in **Clauses 7** and **8** for each implemented record type.

Semantic conformance checks if the content of a record is a faithful representation of the data captured. Individual fields may have explicit semantic requirements in addition to syntactic requirements.

Example 1: for a Type-9 minutiae record, there are minutiae corresponding to each set of coordinates (x, y, t) of the location encoded in the record.

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[5] See **Clause 5.1** for a description of transactions, records and fields.

Example 2: for a Type-10 record, a subject acquisition profile (SAP) level-50 image has semantic requirements including the position and size of the face within the image, angle of view, and lighting.  See **Clause 7.13.1** for the face SAP specifications.


## 3   Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. All standards are subject to revision, and parties that utilize this American National Standard are encouraged to investigate the possibility of applying the most recent versions of the standards indicated below.

AAMVA *International Specification – DL/ID Card Design.* Latest version is applicable. It is available at http://www.aamva.org/KnowledgeCenter/DLIDStandards/

ANSI X3.4-1986 (R1992), *Information Systems --- Coded Character Sets --- 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).*[6]

ANSI/EIA - 538-1988 *Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Equipment.*

ANSI/IAI 2-1988, *Forensic Identification --- Automated Fingerprint Identification Systems --- Glossary of Terms and Acronyms.*[7]

ANSI INCITS 378-2004, *Finger Minutiae Format for Data Interchange.*[8]

ANSI INCITS 379-2004 *Iris Image Interchange Format*[8]

ANSI INCITS 385-2004 *Information technology - Face Recognition Format for Data Interchange*[8]

ANSI INCITS 398 *The Common Biometric Exchange Formats Framework.* Latest version is applicable.

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[6] ANSI X3 Documents available from the American National Standards Institute, 11 West 42nd Street, New York, NY10036.

[7] Available from the International Association for Identification.

[8]  All INCITS documents available from  http://www.incits.org

ANSI/NIST-ITL 1-2000, *Information systems – Data Format for the Interchange of Fingerprint, Facial, and Scar Mark & Tattoo (SMT) Information*.[9]

ANSI/NIST-ITL 1-2007, NIST Special Publication 500-271, *Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information – Part 1*[9]

ANSI/NIST-ITL 2-2008, NIST Special Publication 500-271, *Data Format for the Interchange of Fingerprint,* Facial a*nd Other Biometric Information – Part 2: XML Version*.[9]

ANSI/NIST-ITL 1a-2009, Update to Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information" for multiple finger capture designations. [9]

Department of Defense, Office of GEOINT Sciences (SN), Coordinate Systems Analysis Branch, *Military Grid Reference System*. The latest version is applicable,  available at http://earth-info.nga.mil/GandG/coordsys/grids/mgrs.doc

FBI CJIS, Personal Identity Verification (PIV): Image Quality Specifications for Single Finger Capture Devices, 10 July 2006.[10]

Federal Information Processing Standard 180-x, *Secure Hash Standard.* The latest version applies. It is available at http://csrc.nist.gov/publications/PubsFIPS.html

IAFIS-DOC-01078-x.x Criminal Justice Information Services (CJIS) Electronic Biometric Transmission Specification (EBTS).  Latest version applies.  At the time of this standard's publication, the latest version was dated May 25, 2010.[10]

IAFIS-IC-0110 (V3) WSQ Gray-scale Fingerprint Image Compression Specification, December 19, 1997. [10]

International Electrotechnical Commission Technical Committee NO. 100: Audio, Video and Multimedia Systems and  Equipment,  Project Team 61966: *Colour Measurement and Management in Multimedia Systems and Equipment, IEC/4WD 61966-2-1: Colour Measurement and Management in Multimedia Systems and Equipment - Part 2-1: Default RGB Colour Space – sRGB*, available at http://www.colour.org/tc8-05/Docs/colorspace/61966-2-1.pdf

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[9] Available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm

[10] Available at https://www.fbibiospecs.org/

International Civil Aviation Organization, *Document 9303, Machine Readable Travel Documents*. Latest version is applicable. It is available at http://www2.icao.int/en/MRTD/Downloads/Forms/AllItems.aspx

Internet Society, Internet Engineering Task Force, latest version of *The Base16, Base32, and Base64 Data Encodings* is applicable. It is available at: http://tools.ietf.org/html/rfc4648

Internet Society, Network Working Group. *The Ogg Encapsulation Format* . The latest version is applicable. It is available at http://xiph.org/ogg/doc/rfc3533.txt

ISO 3166-2*, Codes for the representation of names of countries and their subdivisions – Part 2: Country subdivision code* At the time of this standard's publication, the 2007 version was available. The latest version shall apply.[11]

ISO 8601-1988, *Data Elements and Interchange Formats - Information Interchange Representation of Dates and Times*. [11]

JPEG (Joint Photographic Experts Group), *JPEG File Interchange Format, Version 1.02*. Available at http://www.jpeg.org/public/jfif.pdf

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information exchange*[11]

ISO/IEC 10646, UNICODE Standard, latest version is applicable. At the time of publication of this standard, Version 6.0.0 had been released. It is available at http://www.unicode.org/

ISO/IEC 10918, *Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines*[11]

ISO/IEC 14496-2, *MPEG4 Feature Points, Annex C*.[11]

ISO/IEC 15444-1, *JPEG 2000, Information Technology - Digital Compression and Coding of Continuous-Tone Still Images Part 1: Requirements and Guidelines.* [11]

ISO/IEC 15444-2, *Information technology — JPEG 2000 image coding system: Extension, available at:* http://www.jpeg.org/metadata/15444-2.PDF

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[11] All ISO documents are available from the American National Standards Institute,
    11 West 42nd Street, New York, NY 10036 (USA)

ISO/IEC 15948:2004 *Information Technology -- Computer graphics and image processing -- Portable Network Graphics (PNG): Functional specification[11]*

ISO/IEC 19794-5, *Information Technology – Biometric data interchange formats – Part 5: Face image data*. The latest version is applicable. [11]

ITL exchange schema for the namespaces
http://biometrics.nist.gov/standard/2-2011
http://biometrics.nist.gov/standard/2-2008

MTR 04B0000022 (Mitre Technical Report), Margaret Lepley, *Profile for 1000ppi Fingerprint Compression*, Version 1.1, April 2004.[12]  It is  available at:
http://www.mitre.org/work/tech_papers/tech_papers_04/lepley_fingerprint/lepley_fingerprint.pdf

National Crime Information Center (NCIC) Code Manual, Ninth Version, December, 2000.

National Geospatial Intelligence Agency, *World Geodetic System 1984, WGS 84.* The latest version is applicable.  It is described at http://earth-info.nga.mil/GandG/wgs84/

*National Information Exchange Model Naming and Design Rules*, NIEM Technical Architecture Committee (NTAC), October 31, 2008. It is available at:
 http://www.niem.gov/pdf/NIEM-NDF-1-3.pdf

*National Information Exchange Model, NIEM Version 2.1, 2009.* It is available at:
http://www.niem.gov

National Institute of Standards and Technology NISTIR 7300, *NIST FINGERPRINT IMAGE QUALITY (NFIQ) COMPLIANCE TEST,* February 2005. It is available at:
http://www.nist.gov/itl/iad/ig/nbis.cfm#NFIQ

NIEM subset schemas for the namespaces

http://niem.gov/niem/fbi/2.0
http://niem.gov/niem/niem-core/2.0
http://niem.gov/niem/structures/2.0
http://niem.gov/niem/domains/biometrics/1.0
http://niem.gov/niem/ansi-nist/2.0
http://niem.gov/niem/proxy/xsd/2.0
http://niem.gov/niem/appinfo/2.0

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[12] http://www.mitre.org/work/tech_papers/tech_papers_04/lepley_fingerprint/lepley_fingerprint.pdf

NIST Special Publication 800-76, *Biometric Data Specification for Personal Identity Verification.* Latest version is applicable. It is available at: http://csrc.nist.gov/publications/PubsSPs.html

W3C XML and XML Schema, World Wide Web Consortium, Extensible Markup Language, http://www.w3.org/XML *Extensible Markup Language (XML) 1.0 (Fifth Edition)*

*W3C Recommendation* 26 November 2008, Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, François Yergeau.


# 4   Terms and definitions

The following definitions and those given in the American National Standard Automated Fingerprint Identification Systems --- *Glossary of Terms and Acronyms, ANSI/IAI 2-1988*, apply to this standard.

**AABB**

Acronym for the American Association of Blood Banks

**AAMVA**

Acronym for the American Association of Motor Vehicle Administrators.

**ANSI**

Acronym for the American National Standards Institute, Inc.

**Appendix F certified devices**

This refers devices that have successfully completed a test of fingerprint capture devices that is performed in accordance with procedures established by the FBI.  The lists of such approved devices is available at https://www.fbibiospecs.org/

**ASCII**

Acronym for the American National Standard Code for Information Exchange.

**ASCLD**

Acronym for the American Association of Crime Lab Directors

**aspect ratio**

The width-to-height ratio of the captured image.

**BDB**

Acronym for Biometric Data Block used in CBEFF.

**CBEFF**

Acronym for Common Biometric Exchange Formats Framework.  It provides a set of definitions used to exchange biometric data in a standardized manner.  It forms the basis for Type-99 records.

**distal segment**

The segment of a finger or thumb farthest from the palm

**DNA**

Acronym for Deoxyribonucleic Acid.  This is a chemical that forms a double helix that is unique to all but identical siblings.

**domain**

This term has two uses in this standard:

- *Implementation domain* refers to the group of organizations or agencies that have agreed to use a specified set of user-defined fields in a particular format.  This is the domain encoded in Field 1.013 Domain name / DOM.

- *NIEM biometrics domain* refers to an XML namespace that complies with the NIEM naming rules.  It deals with biometric data. See Annex C NIEM-conformant encoding rules for details.

**effective scanning resolution**

The number of pixels per unit distance that remain after a captured image has been subsampled, scaled, or interpolated down to produce an image having a lower value of scanning resolution (fewer pixels per mm) than was used originally to capture the image.

**EFS**

Acronym for the Extended Feature Set for markup of friction ridge data.

**exchange schema**

Though NIEM contains more than 6000 elements it does not contain everything needed in an XML exchange. It contains the most common building blocks. This biometric standard requires an exchange schema, specific to the standard. In addition, implementers may define, in other exchange schemas, "user defined" elements from the implementer's domain.

**EJI - entire joint image**

An exemplar image containing all four full finger views for a single finger.

**element**

In XML, an element is a building block delimited by a start-tag <CaptureDate> and an end-tag </CaptureDate>. Everything between the start-tag and the end-tag of the element (exclusive) is called the element's content. The "fields", "subfields", and "information items" used by traditional-encoding (non-XML) are all represented by XML elements in this encoding.

**exemplar**

The prints of an individual, associated with a known or claimed identity, and deliberately recorded electronically, by ink, or by another medium (also known as Known prints)

**field**

A defined set of data within a record.

**fingerprint**

An image or impression of the friction ridges of all or any part of a finger or thumb.

### forensic

Pertaining to the use of analytic / scientific techniques to establish or verify identity - in this standard, it applies to the examination and mark-up of images (sometimes manually).

### Frankfurt horizon

This is the plane determined by the lowest point of the left eye socket and the tragion of the ears.

### flat fingerprint

A fingerprint image resulting from the touching of a single finger to a livescan platen or paper fingerprint card without any rolling motion. Also known as a single-finger plain impression.

### friction ridge image

An image of an impression from the palmar surfaces of the hands or fingers, or from the plantar (sole) surfaces of the feet or toes.

### friction ridge skin

The papillary skin surface of the surfaces of the hands and fingers, and the plantar surfaces of the feet and toes.

### full finger view

A full finger view is a rolled or plain image of a full-length finger showing all segments. An entire joint image (cf.) includes four full finger view images: one rolled; left, center, and right plain.

### GLP

Acronym for Good Laboratory Practice.  The United States has rules for GLP in *21CFR58*. The Organization for Economic Co-operation and Development (OECD) has stated principles of GLP.

### GPS

Acronym for the Global Positioning System.

**IBIA**

Acronym for International Biometric Industry Association.

**ICC**

Acronym for International Color Consortium.

**IEC**

Acronym for the International Electrotechnical Commission

**ILAC**

Acronym for International Laboratory Accreditation Cooperation

**impression**

A mark containing friction ridge detail produced on a surface by pressure.

**incipient ridge**

A friction ridge not fully developed that may appear shorter and thinner in appearance than fully developed friction ridges.

**INCITS**

An acronym for the InterNational Committee for Information Technology Standards

**instance document**

An XML package described by a schema is called an instance document. If a document satisfies all the constraints specified by the schema, it is considered to be schema-valid.

**interdigital area**

The portion of the palm along the base of the fingers.

**IREX**

Acronym for the Iris Exchange Program. This is a program at NIST in support of iris-based applications based on standardized interoperable iris imagery.

**iris**

A thin, colored, approximately circular structure surrounding the pupil of the eye that contains features used for identification of individuals.

**ISO**

Acronym for the International Organization for Standardization

**IUPAC**

Acronym for the International Union of Pure and Applied Chemistry

**JFIF**

An acronym for JPEG File Interchange Format

**JPEG**

An image compression and storage format specified by the Joint Photographic Experts Group.

**latent print**

An impression or image of friction ridge skin left on a surface.

**MAC address**

Acronym for Media Access Control address, a unique identifier assigned to network interfaces.

**mark**

The point where a needle has pierced the skin, usually associated with drug use.

**medial segment**

The middle segment of the finger. The thumb does not have a medial segment.

**MGRS**

An acronym for the Military Grid Reference System.

**minutia**

The point where a friction ridge begins, terminates, or splits into two or more ridges. Minutiae are friction ridge characteristics that are used to individualize a friction ridge image (fingerprint, palmprint, plantar).

**modality**

This is a type or class of biometric system. Any measurable biological or behavioral characteristic can be a biometric modality.

**mugshot**

Term used interchangeably with facial image.

**native scanning resolution**

The scanning resolution used by a specific AFIS, live-scan reader, or other image capture device and supported by the originator of the transmission.

**NIEM**

Acronym for the National Information Exchange Model. It is a partnership of US Government agencies designed to develop and support information exchange standards using XML.

**NIEM subset schema**

The portion of NIEM needed for a particular exchange.

**NIST**

Acronym for the National Institute of Standards and Technology.

**nominal transmitting resolution**

The number of pixels per unit distance (ppmm or ppi) of the transmitted image. The transmitting resolution may be the same as the scanning resolution for a particular image. On the other hand, the transmitting resolution may be less than the scanning resolution if the scanned image was subsampled, scaled, or interpolated down before transmission.

**NFIQ**

Acronym for NIST Fingerprint Image Quality.

**palmprint**

A friction ridge image from the palm (side and underside) of the hand. A full *palmprint* includes the area from the wrist to the tips of the fingers.

**plain fingerprint**

A fingerprint image resulting from the touching of one or more fingers to a livescan platen or paper fingerprint card without any rolling motion.

**plantar**

The friction ridge skin on the feet (soles and toes).

**ppi**

Acronym for pixels per inch.

**ppmm**

Acronym for pixels per millimeter.

**proximal segment**

The segment of the finger or thumb closest to the palm.

**record**

A defined set of fields, which may be specified by the standard to be mandatory or optional, that contain data as defined in this standard.

**RGB**

Acronym for Red, Green, Blue used to represent color pixels comprised of a specified number of bits to represent each of these primary color components.

**ridge**

A raised portion of the epidermis on the palmar or plantar skin, consisting of one or more connected ridge units of friction ridge skin.

**ridge segment**

A section of a ridge that connects two minutiae; a single non-intersecting portion of a skeletonized image.

**ridge tracing**

See skeletonized image.

**ROI**

Acronym for region of interest.

**rolled fingerprint**

A fingerprint image collected by rolling the finger across a livescan platen or paper fingerprint card from nail to nail. Rolls may be from livescan devices or scanned from paper fingerprint cards.

**SAP**

Acronym for Subject Acquisition Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to a device and modality.

**scar**

Healed tissue that was the result of an accident or medical procedure.

**schema**

An XML schema is a document that describes an XML package. A schema declares the XML elements, their structure and order. A schema assigns data types, names, and attributes to the elements. A schema may be used to validate the structure and content of an XML package.

**semantic conformance**

Conformance to the specifications for the faithful representation of data, as specified in the standard.

**syntactic conformance**

Conformance to the syntax and format requirements of the standard.

**skeletonized image**

A representation of a friction skin image in which all pixels are white except for a 1-pixel-wide thinned black skeleton following the midpoint of each ridge. Also known as a ridge tracing.

**slap image**

Slap fingerprints (slaps) are taken by simultaneously pressing the four fingers of one hand onto a scanner or fingerprint card. Slaps are also known as four-finger simultaneous plain impressions.

**SMT**

Acronym for scar, mark, and tattoo information.

**scanning resolution**

Informally, the number of pixels per unit distance at which an image is captured (ppmm or ppi). More formally, "resolution" (resolving power) is distinct from "sampling frequency" (number of pixels per unit distance). Resolution may be characterized by a measurement of the Spatial Frequency Response (SFR) function. The capture of high quality friction ridge images generally requires an image quality specification, such as the FBI's I*AFIS Image Quality Specification (EFTS Appendix F)* or *Image Quality Specifications for Single Finger Capture Devices (PIV)*, which defines both resolution and sampling frequency. Without such a specification, the term "resolution" is only informational.

**substrate**

Surface upon which a friction ridge impression is deposited.

**tattoo**

An indelible image on the skin that was applied to the skin. A common tattoo results from picking of the skin with a coloring matter. A subclass of tattoo is *chemical*, which indicates that the image was created by the use of chemicals to burn the image into the skin. Another subclass of tattoo is *branded*, which indicates that the pattern was caused by using a branding iron or other form of applied heat. A third subclass of tattoo is *cut*, which indicated that the image was caused by incision of the skin.

**traditional encoding**

The format of transactions used in all versions of this standard prior to, and including that of 2007. It is also included in this standard and is specified in Annex B.

**transaction**

A group of records with information and biometric data concerning a particular individual that is transmitted and / or stored as a complete unit.

**URI**

Acronym for Uniform Resource Identifier.

**URL**

Acronym for Uniform Resource Locator.

**UTF**

Acronym for Unicode Consortium Standard (UCS) Transmission Format

**valley**

A lowered portion of the epidermis on the palmar or plantar skin, consisting of those areas between ridges.

**WAV**

Acronym for the Waveform Audio File Format.


**W3C**

Acronym for the World Wide Web Consortium. It is an international community that develops standards for web development.


**WGS 84 (G873)**

WGS 84 is the World Geodetic System of 1984. At 0000 GMT September 30, 1996 (the start of GPS Week 873), WGS 84 was redefined and was more closely aligned with International Earth Rotation Service (IERS) Terrestrial Reference Frame (ITRF) 94. It is now formally called WGS 84 (G873). WGS 84 (G873) was adopted as the reference frame for broadcast orbits on January 29, 1997.

**XML**

Acronym for Extensible Markup Language.  This forms the basis for the encoding specified in Annex C NIEM-conformant encoding rules. A convention for marking up and tagging data for electronic transmission.  An XML package is built from text content marked up with text tags such as <FingerMissingCode>, <ImageQuality>, and <ImageCommentText> that look superficially like Hypertext Markup Language (HTML) tags.  However, in HTML one is limited to about a hundred predefined tags that describe web-page formatting.  In XML one may create as many tags as needed.  Furthermore, unlike HTML, these tags shall describe the type of content they contain rather than formatting or layout information.

**21 CFR 58**

The *United States Code of Federal Regulations , Title 21 Section 58*.  It states the industry standard for DNA sequencing.  It is available at:
http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=200321

# 5  Data conventions

## 5.1  Structure of a transaction

This standard defines the composition of a transaction that is transmitted to another site or agency. Certain portions of the transaction shall be in accordance with definitions provided by the receiving agency. The transaction shall contain records pertaining to a single subject. Biometric data used to identify another individual requires a separate transaction. However, some records may include biometric data form another person if that data is used to corroborate the identity of the subject of the transaction.

A transaction[13] is comprised of records. All of the records belonging to a single transaction shall be transmitted together. There may be multiple records in a transaction of each record type other than Type-1. The only required record is Type-1, which is used to describe the transaction. There shall be at least one data record accompanying a Record Type-1. The Record types are listed in Table 1.

A record is comprised of fields. Within the standard, each field is assigned a number, a description and a mnemonic. An example is **Field 10.020: Subject pose / POS**. A field is used to transmit a particular datum or closely related data. Data may be arranged in several ways:

- A single type of data that may have multiple entries in a field. This is shown as *Subfield: repeating values* in the record layout tables.

- Single or multiple types of data in a field that do not repeat. These are shown as *information items* in the record layout tables.

- Data with different formats that repeat as a set. These are shown as information items grouped under the heading: *Subfields: Repeating sets of information items*.

The handling of repeating items (subfields) varies by encoding. See Annex B Traditional encoding and Annex C NIEM-conformant encoding rules.

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[13] An ANSI/NIST-ITL transaction is called a file in Traditional Encoding and an Exchange Package in XML encoding.

## 5.2   Record types

### Table 1 Record types

| Record Identifier | Record Contents |
|---|---|
| 1 | Transaction information |
| 2 | User-defined descriptive text |
| 3 | Low-resolution grayscale fingerprint image (Deprecated) |
| 4 | High-resolution grayscale fingerprint image  (for existing systems only) |
| 5 | Low-resolution binary fingerprint image (Deprecated) |
| 6 | High-resolution binary fingerprint image (Deprecated) |
| 7 | User-defined image (for existing systems only |
| 8 | Signature image |
| 9 | Minutiae data |
| 10 | Face, other body part, or scar, mark tattoo (SMT) image |
| 11 | Voice data (future version of the standard) |
| 12 | Dental record data (future version of the standard) |
| 13 | Variable-resolution latent friction ridge image |
| 14 | Variable-resolution fingerprint image |
| 15 | Variable-resolution palmprint image |
| 16 | User-defined variable-resolution testing image |
| 17 | Iris image |
| 18 | DNA data |
| 19 | Variable-resolution plantar image |
| 20 | Source representation |
| 21 | Associated context |
| 22-97 | Reserved for future use |
| 98 | Information assurance |
| 99 | CBEFF biometric data record |

### 5.2.1    Type-1 record

Transmissions to be exchanged are required to contain one and only one Type-1 record per transaction. The Type-1 record shall always be the first record within the transaction. At least one more record shall be present in the file[14]. The Type-1 record shall provide information describing type and use or purpose for the transaction involved, a listing of each record included in the transaction, the originator or source of the physical record, and other useful and required information items.

### 5.2.2    Type-2 records

Type-2 records shall contain user-defined textual fields providing identification and descriptive information associated with the subject of the transaction. Since there are various options available within this standard, a particular user may determine that, for a specific application, field and/or information items that are specified as optional in the standard are to be mandatory for that particular application. The user may also be in the need of additional information not specified in the standard explicitly. The user that is responsible for establishing and maintaining the application profile is the 'domain owner.'

Each entry in a Type-2 record for a particular implementation domain shall have a definition and format that is listed with the Domain owner. Data contained in this record shall conform in format and content to the specifications of the domain name(s)[15] as listed in Field 1.013 Domain name / DOM found in the Type-1 record. A DOM reference therefore uniquely identifies data contents and formats. Each domain shall have a point of contact responsible for maintaining this list. The contact shall serve as a registrar and maintain a repository including documentation for all of its common and user-specific Type-2 data fields. As additional fields are required by specific agencies for their own applications, new fields and definitions may be registered and reserved to have a specific meaning. When this occurs, the domain registrar is responsible for registering a single definition for each number used by different members of the domain. There may be more than one Type-2 record included in each transaction.

### 5.2.3    Type-3 records

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* version of this standard.

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[14]New for this version of the standard. Previous versions only required the presence of Type-1.

[15] This version of the standard allows multiple domains to be specified, unlike previous versions of the standard.

### 5.2.4 Type-4 records

Type-4 records were designed to convey fingerprint images captured by an Automated Fingerprint Identification System (AFIS) live-scan reader, or other image capture devices operating at a nominal scanning resolution of 500 pixels per inch (ppi). Since many older systems still use this record type, it is maintained for backward compatibility. New users are encouraged to utilize record Type-14 to convey fingerprint images. Type-14 records may handle both 500 ppi mages and those at greater resolutions that are now commonly exchanged.

### 5.2.5 Type-5 records

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* version of this standard.

### 5.2.6 Type-6 records

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* version of this standard.

### 5.2.7 Type-7 records

Type-7 is a legacy record type. It was intended as a temporary measure to enable the exchange of image data that would be defined by specific record types in later versions of the standard. Since some older systems still use this record type, it is included in the standard. However, new systems should not use this record type.

### 5.2.8 Type-8 records

Type-8 records shall contain and be used to exchange scanned binary or vectored signature image data. Each Type-8 record shall contain data representing the signature of the subject from whom the biometric sample is being collected and/or the operator capturing biometric data.

### 5.2.9 Type-9 records

Type-9 records shall contain and be used to exchange minutiae or other friction ridge feature data. Each record shall represent the processed (automated and/or manual) image data from which the characteristics are stated. The primary use of this record type shall be for remote searching of latent prints.

### 5.2.10 Type-10 records

Type-10 image records shall contain and be used to exchange face and other body part[16] images, as well as image data from scars, marks, and tattoos (SMT). Textual and analytic information pertinent to the digitized image is also contained in this record type.

### 5.2.11 Type-11 records

Type-11 records are reserved for future use. They will contain voice data samples and data associated with the capture and characteristics of that data. Type-11 records are designed for biometric purposes (speaker recognition) and not for speech recognition or transcription of the vocal content of the voice sample. This record type has not been defined in this version of the standard.

### 5.2.12 Type-12 records

Type-12 records are reserved for future use. They will contain dental record data, used for the identification of individuals and the verification of a person's identity. This record type has not been defined in this version of the standard.

### 5.2.13 Type-13 records

Type-13 image records shall contain and be used to exchange variable-resolution <u>latent</u> friction ridge image data (fingerprint, palmprint and/or plantar) together with fixed and user-defined textual information fields pertinent to the digitized image.

### 5.2.14 Type-14 records

Type-14 image records shall contain fingerprint image data. Fixed and user-defined textual information fields pertinent to the digitized image may also be included. The scanning resolution is not specified for this record type.

### 5.2.15 Type-15 records

Type-15 image records shall contain and be used to exchange palmprint image data together with fixed and user-defined textual information fields pertinent to the digitized image. The scanning resolution is not specified for this record type.

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[16] New for this version of the standard.

### 5.2.16 Type-16 records

The Type-16 image record is designed for developmental purposes and for the exchange of miscellaneous images. This record shall contain and be used to exchange image data together with textual information fields pertinent to the digitized image. Such an image is usually not elsewhere specified or described in this Standard. With the exception of the fields at the start of the record and the descriptors for the image data, the remaining details of the Type-16 record are undefined by this standard and shall be agreed upon between the sender and recipient.

### 5.2.17 Type-17 records

Type-17 image records shall contain iris image data. This record type was developed to provide a basic level of interoperability and harmonization with the *ANSI INCITS 379-2004 Iris Image Interchange Format* and the *ISO/IEC 19794-6 Iris Image Data Interchange Format.* It also contains optional descriptive data fields and image markup fields. Generic iris images may be exchanged using the mandatory fields of this record type.

### 5.2.18 Type-18 records

The Type-18 record[17] shall contain and be used to exchange DNA and related data. It was developed to provide a basic level of interoperability with the draft format of the *ISO/IEC 19794-14 DNA data interchange format*.

With full consideration to privacy, this standard only uses the non-coding regions of DNA. The regions of the DNA that contain genetic information are deliberately avoided.

The record contains the following data.

- Information about the sending and receiving parties for DNA processing
- Descriptors of the biological materials and setting (laboratory or mobile unit) used for generation of the DNA data
- Genotype exchange information
- Information specific to the type of DNA processing that has been performed:
  - Autosomal STR
  - X-STR
  - Y-STR
  - Mitochondrial

---

[17] New for this version of the standard

o   Pedigree

o   Electropherogram image and data.

### 5.2.19   Type-19 records

Type-19 image[18] records shall contain and be used to exchange variable-resolution plantar print image data together with fixed and user-defined textual information fields pertinent to the digitized image.  The scanning resolution is not specified for this record type.

### 5.2.20   Type-20 records

The Type-20[18] record contains source representations employed to create representation used in another record. Typically, one source Type-20 representation is used to generate one or more representations for use in other record types.  When a source representation (in a Type-20 record) is processed and the resulting representation is to be used as the source for further derivations, then the processed representation is contained in a Type-20 record. In some cases, several Type-20 instances may each contain an input (source) representation processed to derive the final representation.  Example uses of the Type-20 record include:

- From a group photo stored in a Type-20 record, a subject's face is segmented and stored in a Type-10 record

- From a high-resolution color image in a Type-20 record, two latent fingerprint images are segmented, rescaled and grayscaled for storage in Type-13 records

- From a series of off-angle face images stored in separate Type-20 records, a single 2D face image is generated (using fusion) that is stored in a Type-10 record.

### 5.2.21   Type-21 records

The Type-21[18] record contains an associated context record.  This information does NOT contain information used to derive biometric information contained in other records.  Record Type-20 serves that function.  Record Type-21 may be used to convey contextual information, such as an image of the area where latent fingerprints were captured.

### 5.2.22   Type-98 records

The Type-98[18] record shall contain security information that allows for the assurance of the authenticity and/or integrity of the transaction, including such information as binary data hashes, attributes for audit or identification purposes, and digital signatures.

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[18] New for this version of the standard.

### 5.2.23 Type-99 records

Type-99 records shall contain and be used to exchange biometric data that is not supported by other ANSI/NIST-ITL record types. This provides a basic level of interoperability and harmonization with other biometric interchange formats. This is accomplished by using a basic record structure that is conformant with *ANSI INCITS 398-2005, the Common Biometric Exchange Formats Framework (CBEFF)* and a biometric data block specification registered with the International Biometrics Industry Association (IBIA)[19].

## 5.3 Backwards compatibility

Backward compatibility is important, since organizations adhering to earlier versions of the standard may create transactions according to that version, and they may still be received by organizations that have updated to conform to a newer version of the standard.

Type-4 (fingerprint images) and Type-8 (signature) records cannot change between versions of the standard due to restrictions in the Traditional encoding format. (In Traditional encoding, they are 'binary' data with a fixed structure) Since the time when these record types were defined, users have needed more flexibility in defining the metadata associated with the fingerprint image data. Thus, Type-14 was developed to replace Type-4 fingerprint image records. However, since several systems exist that still use Type-4 to transmit fingerprint images, that record type is retained in the standard. Type-2 (user-defined descriptive text entries), Type-7 (user-defined image) and Type-16 (user-defined testing image) records are further defined in application-specific documentation.

Record types 9 through 99 may be updated, expanded or introduced with new versions of the standard. New fields in existing records may be added, as well as new data record types. If it is determined by the canvassees that a record type or field or information item is not used or needed, it may be declared 'deprecated.' In this version of the standard, the deprecated record type, field, or information item is not included in the description. There are also certain items that are noted in the standard as being discouraged for use in new applications, but that have not yet been agreed upon by the canvassees to be deprecated.

When a data definition is introduced that causes potential problems with backward compatibility, it is noted in the standard. An example is the definition of 'color space.' See **Clause 7.21.3.** NIEM-conformant XML encoding has inherent backwards compatibility issues due to the need to develop new schemas. This is described in Annex C.

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[19] For more information, go to http://www.ibia.org.

## 5.4  Character types

The data contained in an information item may be of the following types:

- A:     Alphabetic  (26 English letters) and . , ! " " ' ' -
- AN:    Alphabetic and 1 2 3 4 5 6 7 8 9 0 .
- ANS:   Alphanumeric with extended and special characters
- B:     Binary (for Traditional encoding) or Base64 (for XML encoding)
- Base64 Base-64 encoded (exclusively)
- N:     Numeric 1 2 3 4 5 6 7 8 9 0 .
- NS:    Numeric with special characters : - *

At the beginning of each Clause describing the contents of a record type, there is a table listing the layout for that record type.  Each data location in the tables lists the character type, the minimum and maximum number of characters, the data constraints, and the number of times that it may appear.

## 5.5  Character encoding

As stated in **Clause** 5.1 each transaction shall contain one and only one Record Type-1. In order to ensure that the transaction description information can be read by all systems, Record Type-1 shall always be recorded using the 7-bit American National Standard Code for Information Interchange (ASCII).  The eighth (leftmost) bit shall contain a zero value.

XML requires the statement of character encoding at the beginning of a package. Only one character encoding set is used per transaction. As noted in Annex C, UTF-8, is the preferred method of transmitting data in NIEM-conformant XML. Annex A provides information on converting between the different character encoding sets.

The characters "<" and ">" shall not be used in any of the character encoding sets, as is the case with the control characters "$_S^F$", "$_S^G$", "$_S^R$", "$_S^U$", "$_{STX}$" and "$_{ETX}$".  These are reserved characters in Traditional and XML encodings[20].  As a result, Base-64 shall be used for converting non-ASCII text into ASCII form, where required and noted in the standard.

The Type-1 record shall contain **Field 1.015 Directory of character encoding sets / DCS**, which specifies the character encoding sets[21] to be used. A subfield of the DCS is an ordered

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[20] "<" and ">" were reserved characters in the 2008 version.   The others were reserved characters in the 2007 version.  They are all reserved characters in this version.

[21] In previous versions of the standard, the character encoding sets were referred to as Character sets.  This change in terminology was introduced since the encoding sets actually include several character sets, such as Latin characters, Arabic characters, and Cyrillic characters.  The encoding sets show the extent to which character sets are included in them. This change is reflected throughout this version of the standard.

list of 3 information items containing an identifying code, the name of the international character encoding set and its version. The character encoding set specified in XML shall correspond to the XML declaration of encoding statement at the beginning of the XML package (See **Annex C NIEM-conformant encoding rules**). **Annex B Traditional encoding** describes the use of character encoding sets in Traditional encoding[22].

**Table 2 Character encoding sets**

| Character encoding set index | Character encoding set name | Description |
|---|---|---|
| 0 | ASCII | 7-bit English (Default) With zero added in high bit position |
| 1 | ASCII | 8-bit Latin |
| 2 | UTF-16BE (Big-Endian) | 16 bit |
| 3 | UTF-8 | 8-bit |
| 4 | UTF-32 | 32-bit |
| 005-127 | -------------- | Reserved for future use |
| 128-999 | -------------- | User-defined character encoding sets |

# 6   Implementation domain

An implementation domain, codified in **Field 1.013 Domain name / DOM** in a Type-1 record as an optional field, is a group of agencies or organizations that have agreed to use pre-assigned data fields with specific meanings (typically in Record Type-2) for exchanging information unique to their installations.

An example of an implementation domain is the one maintained by the Criminal Justice Information Services (CJIS) Division of the Federal Bureau of Investigation (FBI). It is the North American Domain subscribed to by the Royal Canadian Mounted Police (RCMP), the FBI, and several state and Federal agencies in North America. The default value for this field shall be the North American Domain implementation and shall appear as "NORAM".

---

[22] Note that the 2008 version only allowed one character encoding set, due to the XML restrictions. The 2007 version allowed multiple character encoding sets within a single transaction. This version allows only one character encoding set, in order to conform to the inherent restrictions of XML.

There may be three more optional pairs of information items, with the same format as those described above[23]. They are used when a transmission is conformant with more than one domain specification, such as NORAM, and Texas DPS (Department of Public Safety).

# 7 Data common to several record types

## 7.1 Record header

The record header appears as the first field (xx.001) in each record type. It contains information particular to the encoding format chosen, in order to enable proper reading of the record. In Traditional encoding, this field contains the record length in bytes (including all information separators). In NIEM-conformant XML encoding, this field contains the *RecordCategoryCode*, which is the numeric representation of the Record type.

## 7.2 Information designation character / IDC

Each of the records present in a transaction, with the exception of the Type-1 record, shall include a field (**xx.002**) containing the **Information designation character / IDC**[24]. The value of the IDC shall be a sequentially assigned positive integer starting from zero and incremented by one up to a maximum of 255[25].

IDC references are established in Type-1 **Field 1.014 Greenwich Mean Time / GMT**, and shall be used to relate information items in the CNT field of the Type-1 record to the other records in the transaction.

In addition, two or more records may share a single IDC. Two or more records shall share a single IDC solely to identify and link together records that pertain to the same captured representation of a biometric trait.

- Most frequently, IDCs are used to link a particular finger/palm/plantar image (in a Type - 4, 13, 14, 15, 19 record) with the corresponding Type-9 minutiae record. When different images of a single finger/palm/plantar are captured, each is given a separate IDC, to ensure that the minutiae records correspond to a specific image record.

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[23] New for this version of the standard.

[24] This was called the Image designation character in earlier versions of the standard. The mnemonic is the same.

[25] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

- Two or more **image** records may share a single IDC only when they are enhancements of a single image; such transformations shall have identical dimensions, and shall not be distorted with respect to each other (i.e. a feature at a given position in one image shall be in the same position in the other image.[26]

Other relationships among records are accommodated through use of the Type-20 Source representation and Type-21 Associated context records.

**Field 10.039: Type-10 reference number / T10** explicitly handles Type-10 images that are of the same body part, but may be a general larger image and zoomed-in images[27].

**Field 14.026: Simultaneous capture  / SCF** explicitly links finger images that were captured simultaneously on non-contiguous platens or other image capture capabilities.[27]

The maximum number of records in a transaction is 255.  This is entered in **Field 1.003 Transaction content / CNT** as the information item **Content record count / CRC.**[28]

Examples of the use of IDC follow.

- A criminal arrest transaction that includes fingerprints, palmprints, signatures of the subject and arresting officer, and a mugshot would include distinct records with IDCs ranging from "0" to "23": a Type-1 record, a Type-2 record (IDC 0), 14 Type-14 fingerprint image records (IDCs 1-14), two Type-8 signature records (IDCs 14-16), six Type-15 palmprint records (IDCs 17-22), and a Type-10 facial image (IDC 23).

- A latent print search transaction that includes two latent images with minutiae markup, the original source image from which the latent prints were derived, and a crime scene image would include distinct records with IDCs ranging from "0" to "4":  a Type-1 record, a Type-2 record (IDC 0), 2 Type-13 latent image records (IDCs 1-2), two Type-9 minutiae records (IDCs 1-2, referring to the Type-13 latent image records), a Type-20 source representation image record (IDC 3), and a Type-21 associated context record (IDC 4).

The IDCs are in sequential order in the transaction, with the exception of the linked IDCs.

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[26] Multiple images of a face, taken to be in conformance with SAP 50, each have a unique IDC.  SMT images also each have a unique IDC.  In the case when one is a different image of the same SMT, Field 10.039 is used to link those SMT images.

[27] New for this version of the standard.

[28] Clarification of potential ambiguities in earlier versions of the standard.

The Type-1 record shall be the first record in the transaction, but the records do not otherwise have to be in order by record number.

Two fields, **EFS Field 9.360: Area of Correspondence / AOC** and **EFS Field 9.362: Examiner Comparison Determination / ECD** use IDCs as references to define the relationship between two different prints[29].

## 7.3   Source representation   / SOR

This optional field[29] (**xx.997**) refers to a representation in Record Type-20 with the same SRN, which is the first information item contained in this field. This field is used when the representation transmitted in this record is derived from a source representation.  This field consists of two information items.

- The first information item contains the **Source representation number / SRN** for a particular Record Type-20.  This is mandatory for each SOR.

- The second information item is optional.  It specifies the reference to the segmentation coordinates **Field 20.016: Segments / SEG**   of the source representation in this record type, which is a **Reference type value / RTV**.

### 7.3.1   Source representation / SRN

The SRN shall be used to link a Type-20 record to biometric type records that were derived from it.  The SRN is specified for each Source representation (Type-20) record. This same SRN value is contained as an information item in the SOR (**Field xx.997**) for other Record Types that contain representation(s) derived from this Source representation record.  The value of the SRN shall be a sequentially assigned a positive integer starting from zero and incremented by one, not to exceed 255.

Note that the SRN serves a different purpose than the **Information Designation Character / IDC**.  The SOR does not appear in certain record types.

### 7.3.2   Segment reference type value / RTV

The RTV is associated with the SRN.  It denotes a particular segment of the associated source.  There may be up to 99 segments per image, clip, or other data source in Record Type-20. It appears as an information item in **Field 20.016: Segments / SEG** for in a record with the appropriate SRN.

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[29] New for this version of the standard.

**7.4**  Associated context.

This optional field[30] (**xx.995**) refers to one or more Type-21 records with the same ACN. This field and is used when the representation transmitted in this record is linked to associated context data. This field consists of a maximum of 255 repeating subfields each of which contains two information items

- The first information item contains the **Associated context number value / ACN** for a particular Record Type-21.  This is mandatory for each ASC.

- The second information item is optional.  It specifies the reference to the segmentation coordinates (**Field 20.016: Segments / SEG** ) of the associated context data that is represented in this record type, which is a **Reference type value / RTV**.

### 7.4.1    Associated context number / ACN

The ACN shall be used to link a Type-21 record to biometric type records that are related to it.  The ACN is specified for each Associated context (Type-21) record. This same ACN value is contained as an information item in the ASC (**Field xx.995**) for other Record Types that contain representation(s) linked with this Associated context record.  The value of the ACN shall be a sequentially assigned a positive integer starting from zero and incremented by one, not to exceed 255.

Note that the ACN serves a different purpose than the **Information designation character / IDC**.  The ASC does not appear in certain record types.

### 7.4.2    Associated Segment position / ASP

The ASP is associated with the ACN.  It denotes a particular segment of the associated data. There may be up to 99 segments per image, clip, or other data source in Record Type-21. It appears as an information item in Field 21.016: Segments / SEGfor in a record with the appropriate ACN.

## 7.5   Annotated information / ANN

This field[30] (**xx.902**) is used to store annotation, logging, or processing information associated with one or more processing algorithms or workstations.   If present, this text field shall consist of one or more subfields comprised of a set of information items - each containing up to 300 characters that describe a single processing step.  Four mandatory information items comprise a subfield.

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[30]New for this version of the standard.

- The first information item shall be the **GMT date and time / GMT.** (See **Clause 7.15.2**).

- The second information item (**Processing algorithm name/version / PNV** shall contain an unformatted text string identifying the name and version of the processing algorithm or workstation.

- The third information item (**Algorithm owner / OWN**) shall contain a text string with the contact information for the organization that owns the processing algorithm or latent workstation.

- The fourth and final information item (**Process description / DSC)** shall contain an unformatted text string describing a process or procedure applied to the image in this Type-XX record.

Additional subfields, each describing a subsequent processing step, may follow.

## 7.6   Image hash / HAS

This optional field[31] (**xx.996**) is designed for use in Record types 10 and above with a **Field xx.999**. The value contained in this field shall be a hash value of the data in **Field xx.999**. This enables the receiver of the data to check that the image data has been transmitted correctly, and may also be used for quick searches of large databases to determine if the data already exists in the database. It is comprised of 64 characters representing hexadecimal values.  Thus, each character may be a digit from "0" to "9" or a letter "A" through "F". See the latest version of the *Federal Information Processing Standard 180, Secure Hash Standard* for information on computing SHA-256 hashes. At the time of this standard's publication, *FIPS 180-3* had been published.

## 7.7   Geographic sample acquisition location / GEO

This optional field[31] (**xx.998**) is used in Record Types 10 and above.  It specifies the location where the biometric sample was collected.  There are alternate, optional formats for the geographic information contained in this field.

This optional field is composed of thirteen information items. This field shall be used to document the universal date, time and geographic location where the biometric record was captured.  Geospatial is defined as pertaining to the geographic location and characteristics of natural or constructed features and boundaries on, above, or below the earth's surface; esp. referring to data that is geographic and spatial in nature.

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[31] New for this version of the standard.

The first information item is mandatory.  It is the **Coordinated universal time entry / UTE**. See **Clause 7.15.2.**

The next eight information items (information items 2 through 9) comprise the Geographic Coordinate Latitude/Longitude. They are optional. However, if LTD appears, then LGD shall also be present.  The other entries are optional.

Geographic Coordinate Latitude is measurement of the angular distance between a point on the Earth and the Equator. Geographic Coordinate Longitude is a measurement of the angular distance between a point on the Earth and the Prime Meridian. If a decimal value is used in a particular information item, the more granular information item shall be empty (e.g., if Longitude minutes equals 45.27, Longitude seconds shall be empty).

The second information item is **Latitude degree value  / LTD**. This is a value that specifies the degree of latitude. The value shall be between -90 (inclusive) and +90 (inclusive).

The third information item is **Latitude minute value / LTM**.  This is a value that specifies a minute of a degree. The value shall be between 0 (inclusive) to 60 (exclusive).

The fourth information item is the **Latitude second value  / LTS**. This is a value that specifies a second of a minute. The integer value shall be from 0 (inclusive) to 60 (exclusive).

The fifth information item is the **Longitude degree value / LGD**. It is a value that specifies the degree of a longitude. The value shall be between -180 (inclusive) and +180 (exclusive).

The sixth information item is the **Longitude minute value / LGM**.  It is a value that specifies a minute of a degree. The value shall be from 0 (inclusive) to 60 (exclusive).

The seventh information item is the **Longitude second value / LGS**.  It is a value that specifies a second of a minute. The integer value shall be from 0 (inclusive) to 60 (exclusive).

The eighth information item is **Elevation / ELE**.  It is expressed in meters.  It is a numeric value. It may be negative.

The ninth information item is the **Geodetic datum code / GDC[32]**.  It is an alphanumeric value up to 40 characters in length. This information item is used to indicate which coordinate system was used to represent the values in information items 2 through 7.  If no entry is made in this information item, then the basis for the values entered in the first eight information items shall be the *World Geodetic Survey 1984 version  - WGS 84 (G873)*.

The tenth, eleventh and twelfth information items are treated as a group and are optional. They represent the *Military Grid Reference System (MGRS)*.   These three information items together are a coordinate which represents a location with a Universal Transverse Mercator (UTM) coordinate and a unique military grid square. If any of these three information items is present, all shall be present.

The tenth information item is the **Geographic coordinate universal transverse Mercator zone / GCM**.  It is an alphanumeric value of 4 digits.

The eleventh information item is the **Geographic coordinate universal transverse Mercator easting / GCE**.  It is a numeric value of 2 digits for 1 kilometer precision, 3 digits for 100 meter precision, 4 digits for 10 meter precisions and 5 digits 1 meter precision.

The twelfth information item is the **Geographic coordinate universal transverse Mercator northing / GCN**.  It is a numeric value of 2digits for 1 kilometer precision, 3 digits for 100 meter precision, 4 digits for 10 meter precisions and 5 digits for 1 meter precision.

The thirteenth information item is optional.  It is the **Geographic reference text / GRT**. This information item is an alphanumeric entry of up to 150 characters. It is a free form text describing a street address or other physical location (such as 'Corner of Washington and Madison, Geneva, NY')

## 7.8   Data

**Field xx.999** is reserved in Record Types 10 and above for data associated with the record that is described in the other fields of the record.   It is mandatory in most of these record types (It is optional in Type 18 and does not appear in Type-98).

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[32] See the Glossary maintained by the National Oceanic and Atmospheric Administration for information on commonly used datum. http://www.ngs.noaa.gov/CORS-Proxy/Glossary/xml/NGS_Glossary.xml

## 7.9 Impression Type / IMP

This field[33] contains a code from **Table 3** for how the friction ridge sample was collected.

**Table 3 Friction ridge impression types**

| Description | Code |
|---|---|
| Live-scan plain fingerprint (may be more specific with 20, 22, 24 or 26) | 0 |
| Live-scan rolled fingerprint (may be more specific with 21, 23, 25 or 27) | 1 |
| Not live-scan plain fingerprint | 2 |
| Not live-scan rolled fingerprint | 3 |
| Latent fingerprint impression | 4 |
| Latent fingerprint tracing | 5 |
| Latent fingerprint photo | 6 |
| Latent fingerprint lift | 7 |
| Live-scan fingerprint vertical swipe | 8 |
| Live-scan palm | 10 |
| Not live-scan palm | 11 |
| Latent palm impression | 12 |
| Latent palm tracing | 13 |
| Latent palm photo | 14 |
| Latent palm lift | 15 |
| Live-scan optical contact plain fingerprint | 20 |
| Live-scan optical contact rolled fingerprint | 21 |
| Live-scan non-optical contact plain fingerprint | 22 |
| Live-scan non-optical contact rolled fingerprint | 23 |
| Live-scan optical contactless plain fingerprint (2D image) | 24 |
| Live-scan optical contactless rolled fingerprint (2D image) | 25 |
| Live-scan non-optical contactless plain fingerprint (2D image) | 26 |
| Live-scan non-optical contactless rolled fingerprint (2D image) | 27 |
| Other | 28 |
| Unknown | 29 |
| Live-scan plantar | 30 |
| Not live-scan plantar | 31 |
| Latent plantar impression | 32 |
| Latent plantar tracing | 33 |
| Latent plantar photo | 34 |
| Latent plantar lift | 35 |

[33] This table has been expanded from the 2007 and 2008 version to include plantar impressions.

## 7.10  Friction ridge generalized position / FGP

This field[34] is used in Record types dealing with friction ridges.  It specifies which friction ridge biometric sample was collected.  Note that for codes 1-40 and 60-80 the table specify MAXIMUM width and height. If the image is from a finger (including the lower joints) but the finger position is unknown, the code "0" (Unknown fingerprint) shall be used. If the image is from a palm but the location cannot be determined, the code "20" (Unknown palm) shall be used. If the type of friction skin is unknown, each of the possible positions shall be included as separate data entries. Codes "0" (Unknown fingerprint) and "20" (Unknown palm) together address all friction ridge areas on the hands; codes "37" (Unknown sole of foot) and "40" (Unknown toe) together address all friction ridge areas on the feet.  The codes for sixth fingers and palm grasp are new for this version of the standard.

**Table 4 Friction ridge position code & image dimensions**

| Finger position | Finger code | Max Width (mm) | Max Width (in) | Max Length (mm) | Max Length (in) |
|---|---|---|---|---|---|
| Unknown fingerprint | 0 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right thumb | 1 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right index finger | 2 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right middle finger | 3 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right ring finger | 4 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right little finger | 5 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left thumb | 6 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left index finger | 7 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left middle finger | 8 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left ring finger | 9 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left little finger | 10 | 40.6 | 1.6 | 38.1 | 1.5 |
| Plain right thumb | 11 | 25.4 | 1.0 | 76.2 | 3.0 |
| Plain left thumb | 12 | 25.4 | 1.0 | 76.2 | 3.0 |
| Plain right four fingers | 13 | 81.3 | 3.2 | 76.2 | 3.0 |

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[34] In previous versions of the standard, FGP was used for Finger position, and PLP for Palmprint position. They are now in one table, along with the codes added in ANSI/NIST-ITL 1a-2009, and with the new codes for Plantar.  The name was changed to Friction Ridge Generalized Position.

| Finger position | Finger code | Max Width (mm) | (in) | Max Length (mm) | (in) |
|---|---|---|---|---|---|
| Plain left four fingers | 14 | 81.3 | 3.2 | 76.2 | 3.0 |
| Left & right thumbs | 15 | 81.3 | 3.2 | 76.2 | 3.0 |
| Left sixth finger | 16 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right sixth finger | 17 | 40.6 | 1.6 | 38.1 | 1.5 |
| EJI or tip | 19 | 114.3 | 4.5 | 127.0 | 5.0 |
| Palm Position | Palm code | Max Width (mm) | (in) | Max Height (mm) | (in) |
| Unknown palm | 20 | 139.7 | 5.5 | 203.2 | 8.0 |
| Right full palm | 21 | 139.7 | 5.5 | 203.2 | 8.0 |
| Right writer's palm | 22 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left full palm | 23 | 139.7 | 5.5 | 203.2 | 8.0 |
| Left writer's palm | 24 | 44.5 | 1.8 | 127.0 | 5.0 |
| Right lower palm | 25 | 139.7 | 5.5 | 139.7 | 5.5 |
| Right upper palm | 26 | 139.7 | 5.5 | 139.7 | 5.5 |
| Left lower palm | 27 | 139.7 | 5.5 | 139.7 | 5.5 |
| Left upper palm | 28 | 139.7 | 5.5 | 139.7 | 5.5 |
| Right other | 29 | 139.7 | 5.5 | 203.2 | 8.0 |
| Left other | 30 | 139.7 | 5.5 | 203.2 | 8.0 |
| Right interdigital | 31 | 139.7 | 5.5 | 76.2 | 3.0 |
| Right thenar | 32 | 76.2 | 3.0 | 114.3 | 4.5 |
| Right hypothenar | 33 | 76.2 | 3.0 | 114.3 | 4.5 |
| Left interdigital | 34 | 139.7 | 5.5 | 76.2 | 3.0 |
| Left thenar | 35 | 76.2 | 3.0 | 114.3 | 4.5 |
| Left hypothenar | 36 | 76.2 | 3.0 | 114.3 | 4.5 |
| Right grasp | 37 | 139.7 | 5.5 | 203.2 | 8.0 |
| Left grasp | 38 | 139.7 | 5.5 | 203.2 | 8.0 |

| Plantar Position | Plantar code | Max Width (mm) | (in) | Max Height (mm) | (in) |
|---|---|---|---|---|---|
| Unknown sole | 60 | 139.7 | 5.5 | 203.2 | 8.0 |
| Sole – right foot | 61 | 139.7 | 5.5 | 203.2 | 8.0 |
| Sole – left foot | 62 | 139.7 | 5.5 | 203.2 | 8.0 |
| Unknown toe | 63 | 139.7 | 5.5 | 203.2 | 8.0 |
| Right big toe | 64 | 44.5 | 1.8 | 127.0 | 5.0 |
| Right second toe | 65 | 44.5 | 1.8 | 127.0 | 5.0 |
| Right middle toe | 66 | 44.5 | 1.8 | 127.0 | 5.0 |
| Right fourth toe | 67 | 44.5 | 1.8 | 127.0 | 5.0 |
| Right little toe | 68 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left big toe | 69 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left second toe | 70 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left middle toe | 71 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left fourth toe | 72 | 44.5 | 1.8 | 127.0 | 5.0 |
| Left little toe | 73 | 44.5 | 1.8 | 127.0 | 5.0 |
| Front / ball of right foot | 74 | 139.7 | 5.5 | 76.2 | 3.0 |
| Back / heel of right foot | 75 | 139.7 | 5.5 | 76.2 | 3.0 |
| Front / ball of left foot | 76 | 139.7 | 5.5 | 76.2 | 3.0 |
| Back / heel of left foot | 77 | 139.7 | 5.5 | 76.2 | 3.0 |

**Table 4** is extended with minimum dimensions for common 2 finger and 3 finger combinations[35]. Note that mobile devices may use the codes defined in the above table, as well as those presented below.

| Finger position | Finger code | Min Width (mm) | Min Width (in) | Min Length (mm) | Min Length (in) |
|---|---|---|---|---|---|
| *2-Finger Combinations* | | | | | |
| Right index/middle | 40 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right middle/ring | 41 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right ring/little | 42 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left index/middle | 43 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left middle/ring | 44 | 40.6 | 1.6 | 38.1 | 1.5 |
| Left ring/little | 45 | 40.6 | 1.6 | 38.1 | 1.5 |
| Right index / left index | 46 | 40.6 | 1.6 | 38.1 | 1.5 |
| *3-Finger Combinations* | | | | | |
| Right index/middle/ring | 47 | 63.5 | 2.5 | 38.1 | 1.5 |
| Right middle/ring/little | 48 | 63.5 | 2.5 | 38.1 | 1.5 |
| Left index/middle/ring | 49 | 63.5 | 2.5 | 38.1 | 1.5 |
| Left middle/ring/little | 50 | 63.5 | 2.5 | 38.1 | 1.5 |

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[35] No maximum dimensions are included, but there are practical maximum upper limits to the image size. The minimum areas for codes 42, 45, 48 and 50 may not be sufficient for practical use. The actual size will depend upon the equipment used. It should be noted that codes 13-15 and 40-50 are for simultaneous 2 and 3 and 4 – finger combinations. The titles of the finger combinations are given from the thumb outwards (that is, left to right for the right hand and right to left for the left hand). Code 46 "Right index / Left index" means that the right index placed on the right portion of the imaging area and the left index on the left portion of that same imaging area.

## 7.11  Print position descriptors

If the **Friction ridge generalized position / FGP** (**Field 13.013: Friction ridge probable position / FPP** and **Field 14.013: Friction ridge generalized position / FGP**) is set to 19, then the **Search position descriptors / SPD** and the **Print position coordinates / PPC** shall be specified in Record Types 13 and 14. **Figure 1** and **Figure 2** illustrate the positions of the distal, medial and proximal portions of a finger.  **Table 5** lists the finger views (FV1 through FV4) shown in **Figure 2.**

The position descriptor, **Field 13.014: Search position descriptors / SPD** and **Field 14.014: Print position descriptors / PPD** contain two mandatory information items.

The first information item **(Probable decimal finger position code / PDF)** (0-10) is taken from **Table 4**. A "0" indicates that all the fingers of a possible candidate should be searched.

The second information item **(Finger image code / FIC)** is the code taken from **Table 5** to indicate the portion of the database to search.  Full-length finger joint images use codes FV1 through FV4. **Figure 2** is an illustration of the Entire Joint Image for a middle finger with each of the full finger views and constituent parts identified.  The EJI code is used for the case where all four finger images are to be considered.  For the case where the latent is to be compared to proximal, distal, or medial segments of a finger, this information item will contain the appropriate finger segment character. Multiple portions of the EJI may be listed as a separate subfield.

**Field 13.014: Search position descriptors / SPD**, **Field 14.014: Print position descriptors / PPD**, **Field 13.015: Print position coordinates / PPC** and **Field 14.015: Print position coordinates / PPC** are included to make the standard flexible enough to accommodate many different scenarios and applications.  These fields facilitate searching of latents formatted within Type-13 records against Type-14 records contained in the various databases.  The search of a database by a latent can be narrowed with the use of additional information such as finger position, finger segment, or full finger view. It is unlikely that an entire EJI will ever be left at the scene of a crime.  But a latent may be searched against the EJIs based on a specific finger segment or full finger view. This may be accomplished for a portion of the latent described by the X and Y coordinates.

## 7.12  Print position coordinates / PPC

If finger position code "19" appears in **Field 13.014: Search position descriptors / SPD** or **Field 14.014: Print position descriptors / PPD**  then  **Field 13.015: Print position coordinates / PPC** or **Field 14.015: Print position coordinates / PPC** contains offsets to the locations for the bounding box of the EJI, each of the full finger views, or segments

within the EJI.  When used, this field shall consist of six (6) mandatory information items to describe the type or portion of the latent image contained in this record and its location within an entire joint image.

This information will describe either the location of the entire joint image, one full finger view, or segment.  Individual full finger or segment definitions may be repeated as repeating sets of information items

The first information item is the **Number of the full finger view / FVC** with values of "FV1" through "FV4". Values of "FV1" to "FV4" specify the bounding coordinates for each full finger view. For the case of a fingertip, the first information item shall be "TIP"

The second information item is used to identify the **Location of a segment / LOS** within a full finger view. It will contain the not applicable code "NA" if the image portion refers to a full finger view, tip or to the entire joint image locations.  It shall contain "PRX", "DST", "MED" for a proximal, distal, or medial segment

The third information item is the **Left horizontal coordinate / LHC**.  It is the horizontal offset in pixels to the left edge of the bounding box relative to the origin positioned in the upper left corner of the image.

The fourth information item is the **Right horizontal coordinate / RHC.** It is the horizontal offset in pixels to the right edge of the bounding box relative to the origin positioned in the upper left corner of the image.

The fifth information item is the **Top vertical coordinate / TVC** is the vertical offset (pixel counts down) to the top of the bounding box.

The sixth information item is the **Bottom vertical coordinate / BVC**. It is the vertical offset from the upper left corner of the image down to the bottom of the bounding box. It is counted in pixels.

**Table 5 Joint image segments, tip code and finger view codes**

| Type of Image | Image Code |
|---|---|
| Entire joint image | EJI |
| Rolled tip | TIP |
| Full finger rolled image | FV1 |
| Full finger plain image – left side | FV2 |
| Full finger plain image – center | FV3 |
| Full finger plain image – right side | FV4 |
| Proximal segment | PRX |
| Distal segment | DST |
| Medial segment | MED |

**Figure 1 Palms and finger segment positions[36]**



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[36] Note: Upper palm and lower palm images shall include the interdigital area as overlap for verification. Therefore, the lower and upper palm locations have approximate boundaries in this illustration. It is described in **Clause 8.15**.

**Figure 2 Entire joint image**
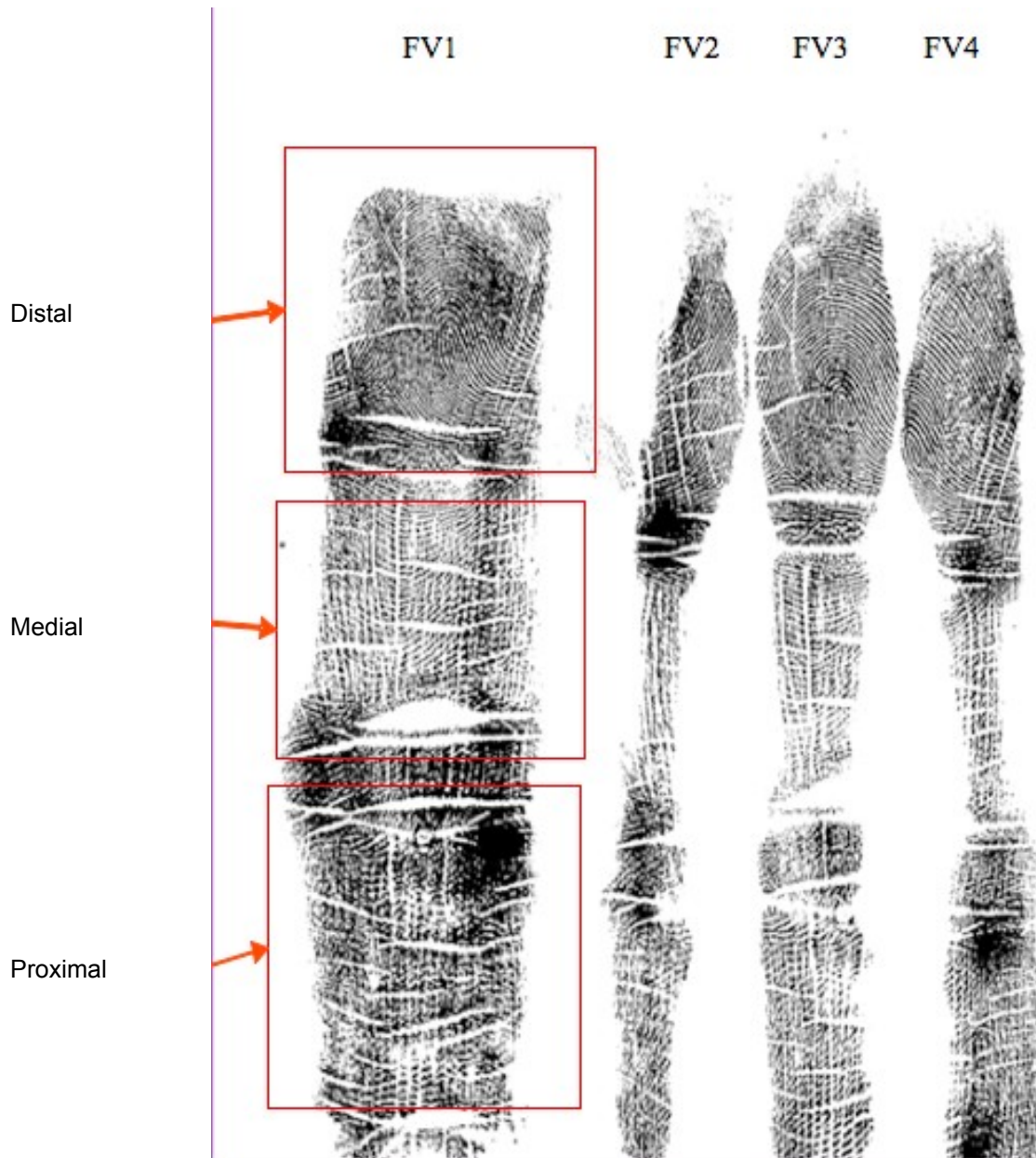
## 7.13  Subject acquisition profile / SAP

A Subject acquisition profile is used to describe a set of characteristics concerning the capture of the biometric sample.  SAP codes are mandatory in Type-10 records with a face image, optional in Type-14 records, and optional in Type-17 records.  The values do not have the same meaning for different modalities.  As is explained in the *Mobile ID Best Practice Recommendation*, a multi-biometric capture device could, for example, have a Face SAP level of 42, Fingerprint SAP level of 45, and an Iris SAP level of 40.  Typically, the higher the value, the stronger the acquisition requirements.

### 7.13.1  Subject acquisition profile for face

**Field 10.013: Subject acquisition profile / SAP** is used to indicate the SAP level code for face as indicated in **Table 6.**

**Table 6 Subject acquisition profiles for face**

| Subject Acquisition Profile | SAP Level |
|---|---|
| Unknown profile | 0 |
| Surveillance facial image | 1 |
| Driver's license image (AAMVA) | 10 |
| ANSI Full Frontal facial image (*ANSI 385*) | 11 |
| ANSI Token facial image (*ANSI 385*) | 12 |
| ISO Full Frontal facial image (I*SO/IEC 19794-5*) | 13 |
| ISO Token facial image (*ISO/IEC 19794-5*) | 14 |
| PIV facial image (*NIST SP 800-76*) | 15 |
| Legacy Mugshot | 20 |
| Best Practice Application – Level 30 | 30 |
| Mobile ID Best Practice - Level 32[37] | 32 |
| Best Practice Application – Level 40 | 40 |
| Mobile ID Best Practice - Level 42[37] | 42 |
| Best Practice Application – Level 50 | 50 |
| Best Practice Application – Level 51 | 51 |
| Mobile ID Best Practice - Level 52[37] | 52 |

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[37] New for this version of the standard.

### 7.13.1.1 Level 0 (Unknown profile)

This level denotes any case when the SAP is unknown. This value may be used to alert systems that the profile of the face image needs to be determined manually or via advanced face image quality evaluation techniques.

### 7.13.1.2 Level 1 (Surveillance facial image)

This SAP denotes a surveillance facial image: a face image captured without specific regard to scene, photographic, or digital requirements. For example, an image of a face from commonly available surveillance video equipment is generally considered a surveillance facial image. Typically surveillance facial images are of relatively poor quality compared to mugshots, including significant pose angle used for the frontal view, poor image resolution, poor image contrast, etc.

### 7.13.1.3 Levels 10-15 (Other application profiles)

Levels 10-15 shall denote transaction associated with capture under the guidance of other facial standards or application profiles as defined below.

Level-10 denotes a driver license facial portrait described in the *AAMVA International Specification – DL/ID Card Design*.

Level-11 denotes an ANSI facial image that meets requirements of the Full Frontal Image type defined in *ANSI INCITS 385-2004.*

Level-12 denotes an ANSI facial image that meets requirements of the Token Face Image type defined in *ANSI INCITS 385-2004.*

Level-13 denotes an ISO facial image that meets the requirements of the Full Frontal Image defined in International standard *ISO/IEC 19794-5.*

Level-14 denotes an ISO facial image that meets the requirements of the Token Face Image type defined in International standard *ISO/IEC 19794-5.*

Level-15 denotes a PIV facial image that meets requirements of Biometric Data Specification for Personal Identity Verification defined in *NIST SP 800-76*.

Note that the facial images of Level-13 and Level-14 may come from travel documents as described in *"Deployment of Machine Readable Travel Documents", ICAO Technical Report, version 2.0*.

### 7.13.1.4 Level 20 (Legacy mugshot)

A facial image conforming to this application profile level shall be a mugshot formatted according to *ANSI/NIST-ITL 2000*, but not necessarily or known to be conforming to the best practice requirements given in level-30.  The subject pose(s) may be Frontal, Profile, or Angled.

### 7.13.1.5 Level 30 (Basic mugshot)

These mugshots shall adhere to strict background, lighting, and resolution requirements. In particular, the background is 18% gray, the lighting is three-point, and the image size is at least 480x600 pixels with an aspect ratio of 1:1.25.

### 7.13.1.6 Level 32 (Mobile device basic mugshot)

The requirements for level 32 are based on those of level 30.  Use of this SAP number indicates that the image was captured with a mobile device.  See **Table 7**.

### 7.13.1.7 Level 40 (Higher resolution mugshot)

A facial image conforming to the level-40 application profile can be captured with an off-the-shelf 1-megapixel camera. Requirements for conformance with level-40 facial image capture include the following:

· The image shall conform to the minimum requirements for the capture of level-30 facial images

· At least one full frontal face image shall be captured.

· The minimum number of pixels in the digital image shall be 768 pixels in the horizontal direction by 1024 pixels in the vertical direction and

· Facial images shall conform to the "head and shoulders" composition detailed requirements shown in **Annex E Best Practices for Facial Capture**.

It should be noted that the resolution aspect of the captured facial images are improved as the number of pixels in both directions are increased. However, as images are captured with an increased number of pixels, the 3:4 (Width : Height) aspect ratio shall be maintained.

### 7.13.1.8 Level 42 (Mobile device higher resolution mugshot)

The requirements for level 42 are the similar to those for level 40. Use of this SAP number indicates that the image was captured with a mobile device. See **Table 7.**

**Table 7 Mobile Device Face SAP levels**

| Capture | ANSI/NIST Comments | Levels | | |
|---|---|---|---|---|
| | | 32 | 42 | 52 |
| Image resolution (size) | Lower resolution may reduce accuracy | ≥ 480x600 | ≥ 768x1024 | ≥ 2400x3200 |
| Capture device sensor | | Progressive scan (no interlace) | Progressive scan (no interlace) | Progressive scan (no interlace) |
| Capture device color space | | Minimum of 24-bit RGB color space or a minimum of 8-bit monochrome color space | Minimum of 24-bit RGB color space or a minimum of 8-bit monochrome color space | Minimum of 36-bit RGB color space or a minimum of 12-bit monochrome color space |
| Capture device controls | | Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed/ flash intensity) based on face area on-board | Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed/ flash intensity) based on face area on-board (requires continuous face detection) | Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed/ flash intensity) based on face area on-board (requires continuous face detection) |
| Capture distance in mm | Lower distance may reduce accuracy | 60-200 cm (~ 2-6 feet), the longer distance is preferred | 60-200 cm, the longer distance is preferred | 60-200 cm, the longer distance is preferred |
| Illuminator type – optional feature | | Xenon flash or LED / fill in flash | Xenon flash or LED / fill in flash | Xenon flash or LED / fill in flash |
| Ambient light[10] | Minimum light level at which flash becomes required | 4 lux | 4 lux | 4 lux |
| Wavelength range | | Visible light, 380-780nm | Visible light, 380-780nm | Visible light, 380-780nm |
| Exposure time | Capability to freeze motion | ≤ 1/100s (10 ms) | ≤ 1/100s (10 ms) | ≤ 1/100s (10 ms) |
| Inter-eye distance | Lower resolution may reduce accuracy | ≥ 90pixels | ≥ 150pixels | ≥ 300pixels |
| Frame rate | For positioning (live view) | ≥ 12 fps | ≥ 12 fps | ≥ 12 fps |

### 7.13.1.9 Levels 50 and 51 (Best practice mugshots)

A facial image conforming to the level 50 and level 51 application profiles shall include "face image capture requirements". These profile levels are intended to allow for examination of up to forensic-level (10 ppmm) detail on a subject's face. The only difference between level-50 and level-51 is that level-50 specifies the "head and

shoulders" composition requirements while level-51 specifies the "head only" composition requirements. Identification applications require approximately 1700 pixels wide by 2515 pixels high on the face for the 99th percentile male in the U.S. population. Allocating 50% of the image width for the head requires approximately 3400 pixels for a "head and shoulders photo" image width.  For a level-50 image capture profile, the minimum number of pixels in the digital image shall be 3300 pixels in the horizontal direction by 4400 pixels in the vertical direction. Off-the-shelf 15 (or more) megapixel digital cameras satisfy this requirement.

As an alternative, allocating 70% of the image width for the head requires approximately 2400 pixels for the "head only" facial capture.  For a level-51 image capture profile, the minimum number of pixels in the digital image shall be 2400 pixels in the horizontal direction by 3200 pixels in the vertical direction. Off-the-shelf 8 megapixel digital cameras satisfy this requirement.

The level-50 and level-51 SAPs allow for the encoding of face images that are consistent with the discussion above and with the "face image capture requirements".  It should be noted that the resolution aspect of the captured facial images might be improved as the number of pixels in both directions are increased. **Figure 3** illustrates the improvement in image quality from levels 30 to 50/51.  However, as images are captured with an increased number of pixels, the 3:4 (Width : Height) aspect ratio shall be maintained.



**Figure 3 Examples of resolution for face SAP levels 30/32, 40/42, & 50/51/52**

*7.13.1.10  Level 52 (Mobile device best practice mugshots)*

The requirements for level 52 are those for level 50, except captured with a mobile device..  Use of this SAP number indicates that the image was captured with a mobile device. See **Table 7**.

### 7.13.2   Subject acquisition profile for fingerprint

The SAP levels for fingerprint acquisition are optional and are based upon those listed in the *Mobile ID Best Practice Recommendation.*   They are entered in **Field 14.031: Subject acquisition profile / SAP.** [38]

**Table 8 Subject acquisition profiles for fingerprint**

| CAPTURE | SAP 10 | SAP 20 | SAP 30 | SAP 40 | SAP 45 | SAP 50 | SAP 60 |
|---|---|---|---|---|---|---|---|
| Acquire flat images | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Acquire rolled images | No | No | No | Optional | Optional | Optional | Optional |
| Minimum scanning resolution | 490 ppi – 510 ppi | 490 ppi – 510 ppi | 490 ppi – 510 ppi | 490 ppi – 510 ppi | 495 ppi – 505 ppi | 495 ppi – 505 ppi | 495 ppi – 505 ppi |
| Minimum image dimensions (w x h) | 256 | 256 | 256 | 256 | 256 | 256 | 256 |
| Maximum Compression Ratio | 10:1 | 10:1 | 10:1 | 15:1 | 15:1 | 15:1 | 15:1 |
| Minimum image area | .5" x .65" | .5" x .65" | .6" x .8" | .8" x 1.0" | 1.6" x 1.5" | 1.6" x 1.5" | 3.2" x 3.0" |
| Simultaneous number of fingers | 1 | 1 | 1 | 1 to 2 | 1 to 2 | 1 to 3 | 1 to 4 |
| Sensor certification | PIV | PIV | PIV | PIV | Appendix F | Appendix F | Appendix F |

### 7.13.3   Subject acquisition profile for iris

The SAP levels for iris acquisition[38] are optional and are based upon those listed in the *Mobile ID Best Practice Recommendation.*   They are entered in **Field 17.031: Subject acquisition profile / SAP. Table 9** lists the differences between the SAP levels.

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[38] New for this version of the standard.

**Table 9 Subject acquisition profiles for iris**

| CAPTURE | SAP 20 | SAP 30 | SAP 40 |
|---|---|---|---|
| **Iris diameter in true, non up-sampled pixels** | ≥ 140 pixels | ≥ 170 pixels | ≥ 210 pixels |
| **Number of (quasi-) simultaneously captured eyes** | ≥ 1 | ≥1 | 2 |
| **Exposure time** | ≤ 33 ms | ≤ 15 ms | ≤ 10 ms |
| **Viewfinder & image quality feedback** | External or internal | Internal, optical or electronic | Internal, at least electronic |

## 7.14  Resolution

Image resolution requirements are applicable to fingerprint, palmprint, plantar and signature images.  Facial, SMT, and iris images, which rely on the total number of pixels scanned and transmitted, are not dependent on the specific scanning resolution used.

### 7.14.1  Fingerprint resolution accuracy requirement

For Appendix F[39] certified devices, resolution accuracy shall not vary more than 1% from the class resolution. A class resolution of 19.69 ppmm (500 ppi) has a lower bound of 19.49 ppmm (495ppi) and an upper bound of 19.89 ppmm (505ppi). (see **Table 10**)

For Personal Identity Verification (PIV)[40] certified devices with fingerprint Subject Application Profile (SAP)[41] Levels 10 to 40 only (see **Clause 7.13.2**), resolution accuracy shall not vary more than 2% from the class resolution (see **Table 10**). For example, a class resolution of 19.69 ppmm (500 ppi) has a lower bound of 19.30 ppmm (490ppi) and an upper bound of 20.08 ppmm (510ppi).  The 2% tolerance for class resolution applies only to verification/authentication applications – not to identification applications.  SAP 10 is a minimum requirement and any SAP level below 10 is not covered by this standard.  See **Table 8** for a description of the fingerprint SAP levels.

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[39] IAFIS-DOC-01078-9.1 Criminal Justice Information Services (CJIS) *Electronic Biometric Transmission Specification (EBTS)* May 25, 2010 – *Appendix F - CJIS Image Quality Specifications*

[40] Personal Identity Verification (PIV): *Image Quality Specifications For Single Finger Capture Devices*.

[41] NIST Special Publication 500-280, *Mobile ID Device Best Practice Recommendation Version 1.0*

**Table 10 Class resolutions with maximum variance**

| Certification | Maximum Variance | Class Resolution | |
| --- | --- | --- | --- |
| | | 500 | 1000 |
| Appendix F | ±1% | ±5ppi | ±10ppi |
| PIV (SAP Level 10 or above) | ±2% | ±10ppi | Not Applicable |

Tolerance requirements shall apply to the class and nominal resolution requirements throughout this document.

### 7.14.2 Friction ridge scanner resolution requirement

Exemplar images shall have a minimum class scanning resolution of 500 ppi. Latent images should have a minimum class scanning resolution of 1000 ppi.

The migration path to higher scanning resolutions for image capturing devices with a native scanning resolution of the 500 ppi class (19.69 ppmm) shall be at a rate of 100% of the current native scanning resolution. The recommended migration path progresses from 19.69 ppmm to 39.37 ppmm (500 ppi class to 1000 ppi class), from 39.37 ppmm to 78.74 ppmm (1000 ppi class to 2000 ppi class), etc. Capture devices with native scanning resolutions not in step with this migration path shall provide (through subsampling, scaling, or interpolating downward) a nominal resolution that matches the next lower interval in the migration path[42]. For example, a device with native scanning resolution of 47.24 ppmm (1200 ppi) shall provide a class resolution of 39.37 ppmm (1000 ppi).

Each image formatted in accordance with this standard shall appear to have been captured in an upright position and approximately centered horizontally in the field of view. The scanning sequence (and recorded data) shall appear to have been from left-to-right, progressing from top-to-bottom. For the purpose of describing the position of each pixel within an image to be exchanged, a pair of reference axes shall be used. The origin of the axes, pixel location (0,0), shall be located at the upper left-hand corner of each image. The x-coordinate (horizontal) position shall increase positively from the origin to the right side of the image. The y-coordinate (vertical) position shall increase positively from the origin to the bottom of the image.

If Type-4 or Type-7 records are included in the transaction, **Field 1.011 Native scanning resolution / NSR** contains five characters specifying the native scanning resolution in pixels per millimeter. It is expressed as two numeric characters followed by a decimal point and two more numeric characters (e.g. 19.69). This field is set to "00.00" if no Type-4 or Type-7 records are present in the transaction. Record Type-14 shall be used if scanning a fingerprint image at the 1000 ppi class or above239. An appropriate Record Type above 9 shall be used if scanning an other image at greater than 99.99 ppmm, rather than using a Type-7 record,

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[42] Clarification of potential ambiguities in earlier versions of the standard.

since that is the maximum possible number for that Record Type. There is no specific Field specifying the scanning resolution for other record types.

### 7.14.3 Friction ridge transmitting resolution requirement

Each image to be exchanged shall have a specific resolution associated with the transmitted data. This transmitting resolution does not have to be the same as the scanning resolution. However, the transmitting resolution shall be within the range of permissible resolution values for that record type. When an image is captured at a scanning resolution greater than the permissible upper limit of the transmitting resolution for that record type, the image shall be subsampled, scaled, or interpolated down. This processing to reduce the scanning resolution to a lower nominal resolution shall be performed before the transmission occurs. Processing to increase the resolution above scanning resolution is not permitted.

If Record Type-4 is used and images are scanned at a step in the migration path greater than the class of 500 ppi, they shall be subsampled, scaled down, or interpolated down to produce a class resolution of 500 ppi for transmission. Record Type-14 shall be used if transmitting a fingerprint image at greater than 20.08 ppmm (510 ppi)[43].

If Record Type-4 or Record Type-7 is used, **Field 1.012 Nominal transmitting resolution / NTR** shall specify the transmitting resolution in pixels per millimeter. It is expressed as two numeric characters followed by a decimal point and two more numeric characters (e.g. 19.69). The transmitting resolution shall be within the range 19.30 ppmm (490 ppi) to 20.08 ppmm (510 ppi) for a Type-4 record. For example, a sensor that scans natively at 508 ppi would list both NSR and NTR as 20 ppmm (=508 ppi). These images should not be sampled down to exactly 500ppi239. Type-7 records may have a scanning resolution up to 99.99 ppmm. This field is set to "00.00" if no Type-4 or Type-7 records are present in the transaction.

For variable-resolution images (those in Record Types 10 and above), the transmitting resolution shall be at least as great as the class resolution of 500ppi. There is no upper limit on the variable-resolution rate for transmission. However, the transmitting resolution shall not be greater than the scanning resolution.

The migration path to higher transmitting resolutions is the same as for the scanning resolutions. That is, to progress from 500 ppi class to 1000 ppi class, from 1000 ppi class to 2000 ppi class, etc. For images captured at a native scanning resolution greater than the permissible upper limit of a transmitting resolution step in the migration path, it may be necessary to subsample, scale, or interpolate down. The result of this processing is to obtain a nominal scanning resolution that conforms to a step in the transmission migration path.

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[43] Clarification of potential ambiguities in earlier versions of the standard.

For variable resolution records, the **Horizontal Pixel Scale / HPS and the Vertical Pixel Scale / VPS** shall be specified. (See **Clause 7.19).** Before transmitting variable-resolution records, the operational capabilities of the sending and receiving systems should be addressed, and prior agreement should be made with the recipient agency or organization before transmitting the image.

## 7.15  Date and time

### 7.15.1  General

YYYY designates the four-digit year, MM designates the month (01 through 12), DD represents the day of the month (01 through 31), hh represents the hour (01 through 24), mm represents the minute (1 through 59), and ss represents the seconds (1 through 59). The date (and time, if applicable) shall not exceed the current date in any field and shall be a legitimate date (and time, if applicable).

The time and date fields are handled differently for each encoding. The Traditional encoding represents the time and date as a numeric value (such as "20110308" representing March 8, 2011). NIEM-conformant encoding places the date in an element formatted as "2011-03-08". The value is shown as "2011-03-08T05:25:00Z" in the case of Greenwich mean time (See **Clause 7.15.2**). The "T" is a fixed character that indicates the separation of the date and the time in the alphanumeric string. In the text of the document, the format of the Traditional encoding is presented, but the user shall format the date and time properly according to the encoding (Traditional, NIEM-conformant, or other). In all cases, the content shall be identical, regardless of the encoding. See Annex B Traditional encoding and Annex C NIEM-conformant encoding rules for details.

### 7.15.2  Greenwich mean time (Coordinated universal time – UTC) / GMT

UTC has replaced GMT as the main reference time scale terminology, but the older terminology is retained in this standard for existing record types. In this standard, **Field 1.014 Greenwich Mean Time / GMT**shall be taken to mean the UTC value. Some newer record types using this format refer to the data as UTC (such as in **Field 18.013: Sample collection date / SCD**). This time is independent of the actual time zone where the time and date is recorded. The data is YYYYMMDDhhmmssZ, where the Z is indicates the zone description of 0 hours.

### 7.15.3  Local date

The local date is recorded as YYYYMMDD. Note that this may be a different date than the corresponding GMT, due to time zone differences.

### 7.15.4 Local date & time

The local date and time is recorded as YYYYMMDDhhmm. Note that this may be a different date than the corresponding GMT, due to time zone differences. It is reflective of the local time, such as Daylight Savings Time.

### 7.15.5 Time index / TIX

For Type-20 or Type-21 records containing video or audio. This field[44] shall contain the start and end times of segments within a video or audio file, measured in hh:mm:ss.$_{sss}$ where ss.$_{sss}$ refers to the seconds and thousandths of seconds. This field is comprised of one or more subfields. Each repeating subfield corresponds to a single segment, with a starting and end time as separate information items. Audio segments should begin and end a few seconds before/after the subject speaks for maximum performance of speech algorithms.

## 7.16 Agency codes

This information appears in a variety of fields, and is handled the same in all such fields. The agency information contains the identification of the administration or organization and may be up to 35 characters. The 2007 version of the standard stated that these fields shall contain a minimum of 9 characters, which is retained in this version. The data content of this field is defined by the user and shall be in accordance with the receiving agency.

In the 2007 version of the standard, these fields are comprised on one information item. The 2008 version of the standard added a second optional information item, which is a text description of the organization name. This second information item is optional for all encodings in this version of the standard.

## 7.17 Device monitoring mode / DMM

This optional information item describes the level of human monitoring that was associated with the biometric sample capture. Alphabetic values are selected from **Table 11**.

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[44] New for this version of the standard.

**Table 11 Device monitoring mode**

| Condition | Description |
|---|---|
| CONTROLLED | Operator physically controls the subject to acquire the biometric sample |
| ASSISTED | Person available to provide assistance to subject submitting the biometric |
| OBSERVED | Person present to observe operation of the device but provides no assistance |
| UNATTENDED | No one is present to observe or provide assistance |
| UNKNOWN | No information is known |

## 7.18 Sample quality

Many of the Record Types contain optional quality metric information. In addition to the three information items described here, the field may contain identifying segmentation information (such as for an individual finger in a multi-fingerprint image). Each of the information items is contained in a set. Multiple sets of information items may be present, each indicating a different quality algorithm, up to a maximum of 9 times[45]. The meaning attributed to this metric shall be defined and interpreted by the producer of the scoring algorithm or by the person or system used to assign the metric to the sample. The metric may be a predictor of false rejection performance or another metric indicating a value associated with the quality of the sample for a particular function.

The first information item shall be a quantitative expression of the predicted matching performance of the biometric sample, which is a **Quality value / QVU**. This information item shall contain the integer image quality score between 0 and 100 assigned to the image data by a quality algorithm. Higher values indicate better quality. An entry of "255" shall indicate a failed attempt to calculate a quality score. An entry of "254" shall indicate that no attempt to calculate a quality score was made.

A second information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score, which is an **Algorithm vendor identification / QAV**. This 4-digit hex value is assigned by IBIA and expressed as four characters. The IBIA maintains the Vendor Registry of CBEFF Biometric Organizations that map the value in this field to a registered organization.

A third information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but registration is not required. This is the **Algorithm product identification / QAP** that indicates which of the vendor's algorithms was used in the calculation of the quality score. This information item contains the integer product code and should be within the range 1 to 65,534.

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[45] This upper limit has been stated to maintain consistency across all encodings and record types. In some places in the 2008 version, it was unlimited; another was limited to 1; some had 9. In 2007, there were places limited to 4; others to 9.

## 7.19  Image scale values

Most image records have mandatory fields for the following items:

- **Horizontal line length / HLL**

  - The number of pixels contained on a single horizontal line of the image. The maximum horizontal size is limited to 65,534 pixels in Record Types-4 and 8 and to 99,999 for other record types. The minimum value is 10 pixels. [46]

- **Vertical line length / VLL**

  - The number of horizontal lines contained in the image. The maximum vertical size is limited to 65,534 pixels in Record Types-4 and 8 and to 99,999 for other record types. The minimum value is 10 pixels. [46]

- **Scale units / SLC**

  - The image sampling frequency (pixel density). A value of "1" shall indicate pixels per inch. A value of "2" shall indicate pixels per millimeter. A value of "0" in this field indicates that no scale is provided, and the quotient of HPS/VPS shall provide the pixel aspect ratio.

- **Horizontal pixel scale / HPS**

  - The integer pixel density used in the horizontal direction of the image if SLC has a value of "1" or "2". If SLC has a value of "0", this information item shall contain the horizontal component of the pixel aspect ratio, up to 4 digits.

- **Vertical pixel scale / VPS**

  - The integer pixel density used in the vertical direction of the image if SLC has a value of "1" or "2". If SLC has a value of "0", this information item shall contain the vertical component of the pixel aspect ratio, up to 4 digits.

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[46] Some places in the 2007 standard restricted the maximum to 4 digits (9,999). Others allowed up to 65,534. The 2007 version restricted the minimum to three digits (100) in some places. The 2008 version gave examples using 2 digits in Record Type-10. To maintain consistency across encodings and record types, the minimum and maximum are set to 2 digits and 5 digits. This equates to a maximum of 99,999 for most record types, except for 4 and 8 which are restricted to 2 bytes in traditional format (65,534).

Some record types have a mandatory field **Bits per pixel / BPX**. This contains the number of bits used to represent a pixel. This field shall contain an entry of "8" for normal grayscale values of "0" to "255". Any entry in this field greater than "8" shall represent a grayscale pixel with increased proportion. A maximum of 2 digits is allowed for this field.

Additional optional fields related to scanning are contained in certain Record Types:

- **Scanned horizontal pixel scale / SHPS**

  The horizontal pixel density used for the scanning of the original image / impression providing that the SLC field contains a "1" or "2". Otherwise, this shall indicate the horizontal component of the pixel aspect ratio, up to 4 digits.

- **Scanned vertical pixel scale / SVPS**

  The vertical pixel density used for the scanning of the original image / impression providing that the SLC field contains a "1" or "2". Otherwise, this shall indicate the vertical component of the pixel aspect ratio, up to 4 digits.

## 7.20  Compression algorithms

Images shall be compressed only from an original uncompressed image. If an image has been received in a compressed format, it shall not be uncompressed and re-compressed in the same or different format.

Regardless of the compression algorithm used, the image shall be represented as an array of n rows by m columns by at least 8-bit pixels. Each pixel in a monochrome image shall be represented by eight or more bits. Color images shall be represented as a series of sequential samples of a red, green, and blue intensity for each pixel. (Other color schemes are also possible. See **Clause 7.21.3).** The image shall be organized in row-major order, with the lowest address corresponding to the upper left corner of the image.

The "JPEGB" algorithm indicates that the scanned or captured image was compressed using baseline JPEG. An entry of "JPEGL" indicates that the lossless mode of the JPEG algorithm was used to compress the image. If the image is captured in grayscale, then only the luminance component shall be compressed and transmitted. For JPEG, the data shall be formatted in accordance with the *JPEG File Interchange Format, Version 1.02 (JFIF).*

An entry of "JP2" indicates that the scanned or captured image was compressed using lossy JPEG 2000. (Conformance with *ISO 15444-1* is provided through part 4 of the standard,

*ISO 15444-4 "Conformance Testing*".) An entry of "JP2L" indicates that the lossless mode of the JPEG 2000 algorithm was used to compress the image. For JPEG 2000, the data shall be formatted in conformance with JP2 format as described in *ISO 15444-1*.

Wavelet scalar quantization (WSQ) specifications are contained in *WSQ Gray-scale Fingerprint Image Compression Specification, December 1997,* which was issued by the Federal Bureau of Investigation. The FBI maintains a list[47] of certified WSQ implementation, based upon testing performed at NIST[48].

Portable Network Graphics (PNG) is an image format specified in *ISO/IEC 15948*.

### Table 12 Compression codes

| Algorithm Name | Code | Mnemonic |
|---|---|---|
| Uncompressed | 0 | NONE |
| WSQ Version 2.0 or Version 3.0 | 1 | WSQ20 |
| JPEG ISO/IEC 10918 (Lossy) | 2 | JPEGB |
| JPEG ISO/IEC 10918 (Lossless) | 3 | JPEGL |
| JPEG 2000 ISO/IEC 15444-1 (Lossy) | 4 | JP2 |
| JPEG 2000 ISO/IEC 15444-1 (Lossless) | 5 | JP2L |
| Portable Network Graphics | 6 | PNG |

#### 7.20.1    Use of compression algorithms for friction ridge images

The Wavelet Scalar Quantization (WSQ), or the JPEG 10918 standard algorithms are recommended for compressing the grayscale data at 500 ppi. When JPEG 2000 is used for the compression of fingerprint images, specifications and options contained in *Profile for 1000ppi Fingerprint Compression* shall apply.

#### 7.20.2    Use of compression algorithms for iris images

For iris images, images may be uncompressed or compressed. The compression code shall be one of the following:

– NONE – An entry of "NONE" in this field indicates that the data contained in this record is uncompressed. The image shall be represented as an array of n rows by m columns. Each pixel in a monochrome image shall be represented by eight or more bits.

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[47] The list is available at https://fbibiospecs.org/

[48] The compliance testing is described at http://www.nist.gov/itl/iad/ig/wsq_compliant.cfm

Color images shall be represented as a sequential sample of a red, green, and blue intensity for each pixel (if using RGB - See **Clause 7.21.3**). The image shall be organized in row-major order, with the lowest address corresponding to the upper left corner of the image.

– PNG – This supports lossless compression. PNG is formally standardized (*ISO/IEC 15444*) and implementations are freely available[49] (libpng).

– JPEG 2000 – This support both lossy and lossless compression. As with other biometrics, while lossless compression is preferred, iris images can be lossy-compressed. The Image Type (**Field 17.032: Iris storage format / ISF**) should be selected appropriately, and the compression ratio should be set to satisfy some known quantified storage or transmission bandwidth limitation.

The baseline JPEG algorithm (*ISO/IEC 10918*) is not acceptable for iris images and shall not be used. It has been shown that false match rates increase due to the presence of tiling artifacts. While JPEG was allowed in prior versions of this standard for iris compression, it is not allowed for this version. Implementers may want to support JPEG decoding for handling legacy images.

### 7.20.3    Use of Compression algorithms for facial images

Where JPEG 2000 is used for compression of facial images, the following shall apply:

Filters: The 9-7 irreversible filters described in *ISO 15444-1* should be used for lossy mode; however for handheld devices (fixed point processors), the 5-3 reversible filters may be used instead. The 5-3 reversible filters shall be used for lossless mode. A conformant decoder shall be able to decode code streams created through both filters.

Number of resolution levels: The image shall be encoded using enough resolution levels to ensure that a thumbnail with max (width, height) $\leq$ 64 is available in the image. Example: a 640 x 480 image shall be encoded with 5 resolution levels, which enables sub-resolution decodes of 320 x 240, 160 x 120, 80 x 60, and 40 x 30.

Resolution as the dominant progression: JPEG 2000 allows five progression orders - LRCP, RLCP, RPCL, PCRL and CPRL. The RLCP progression order (resolution, layer, component, position) shall be used since it best facilitates decode and display of lower resolution derivative images by remote networked devices. Through the RLCP progression order, the code stream shall be formatted so that the resolution information of the image is the first data made available to a decoder in a streaming mode of operation.

Bits per channel: The number of bits per channel for encoders and decoders shall be 8-16

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[49] See http://www.libpng.org/pub/png/libpng.html

bits.

Single tile images: Facial images shall be encoded using only single tile to avoid tiling artifacts.

JPEG 2000 quality layers: The image shall be encoded using at least 10 quality layers to enable quality progressive decoding or sub-quality image extraction.

Region of Interest (ROI) Encoding is allowed: This encoding method is a useful way to compress a facial image to a small size, while retaining sufficient image quality within the specified ROI to perform either human or automated identification.

### 7.20.4    Use of Compression algorithms for other images

Many image record types contain a mandatory field **Compression algorithm / CGA**. An entry of "NONE" in this field indicates that the data contained in this record is uncompressed.   If a restriction on compression is required for the image type, it is referenced in that Clause.

 Record Types 20 and 21 allow the transmission of other types of file formats than those used to store the biometric sample.  **Field 20.015: Source representation format / SFT** and **Field 21.015: Associated context format / AFT** are comprised of two information items.

- The first information item, **file suffix type / FST,** shall be an alphanumeric value of up to 5 characters.  It contains values such as OOG[50], JPG, WAV, and PNG.

- The second information item, **special encoding and decoding specifications / SCS,** is optional and shall describe any specialized and / or proprietary software.  This shall be an alphanumeric text entry of up to 1000 characters, allowing special characters.

## 7.21  Color, black-and-white, and grayscale image requirements

### 7.21.1    Black and white images (no grayscale)

Image data may be transmitted in either compressed or uncompressed form.   The Uncompressed binary images shall consist of pixels, each of which shall be quantized to one of two levels (binary representation).  A value of zero shall be used to represent a white pixel and a value of one shall be used to represent a black pixel.   For transmission of uncompressed binary images, eight pixels shall be left justified and packed into a single unsigned byte.   The most significant bit of the byte shall be the first of the eight pixels scanned.

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[50] A multimedia format for audio files. For information, see http://xiph.org/ogg

### 7.21.2   Grayscale image data

Grayscale image data may be transmitted in either compressed or uncompressed form.  The transmission of uncompressed grayscale images shall consist of pixels, each of which shall normally be quantized to eight bits (256 gray levels) and held in a single unsigned byte. Increased precision for pixel values greater than 255 shall use two unsigned bytes to hold sixteen-bit pixels with values in the range of 0-65533.  For grayscale data, a zero shall represent a true black pixel.  A true white pixel shall have all of its bits of precision set to "1".  Therefore, true white pixels quantized to eight bits shall have a value of "255", while a value of "1023" shall be used for pixels quantized to ten bits. Grayscale values requiring less than 8 or 16 bits shall be expressed as one or two bytes, right justified and zero padded on the left.

For grayscale images, in Record types with the mandatory field **Color space / CSP**, the value shall be "GRAY" (see **Table 13**). The transmission of compressed grayscale images shall be the output of the appropriate grayscale compression algorithm specified.  Upon reconstruction of a compressed image the grayscale value for each pixel shall be the same (for lossless algorithms) or nearly the same (for lossy algorithms) as pixels in an uncompressed image.

### 7.21.3   Color image data

Scanned images shall consist of nominal 24 to 48-bit RGB pixels.  Color image data may be transmitted in either compressed or uncompressed form in certain record types. The transmission of uncompressed color images shall consist of RGB pixels, each component of which shall be quantized to at least 256 levels (8 bits). For each pixel, the three components shall be sequentially formatted for transmission on a pixel-by-pixel basis.

**Table 13** lists the codes and their descriptions for each of the available color spaces used within this standard.  All other color spaces are to be marked as undefined.

**Table 13 Color spaces**

| Code | Description |
|------|-------------|
| UNK | Undefined |
| GRAY | Grayscale (monochrome) |
| RGB | Undetermined color space for an RGB image |
| SRGB | sRGB (IEC 61966-2-1) |
| YCC | YCbCr (legacy) |
| SYCC | YCbCr (JPEG 2000 compressed) |

Several image record types have a field **Color space / CSP.** It shall contain an entry from the CODE column of **Table 13**. If the color space for an RGB image cannot be determine, an entry of "RGB" shall be entered in this field.

In versions of this standard prior to 2007, the term "color space" referred to device-dependent color information with a particular sequence and range for the three color channels. The choice was either RGB or an RGB-derivative space known as YCC. Neither space provides an objective definition of a particular color or relates to the way in which humans perceive color.

For JPEG compressed color images stored in the JFIF format, the preferred (external) color space is sRGB and an entry of "SRGB" shall be used. Although sRGB is the preferred color space for compressed images for this version, in the 2000 version of this standard, it was stated that "the preferred color space for compressed images using baseline JPEG and JFIF is YCbCr to be coded as 'YCC'," while the color space for uncompressed color images was to be labeled RGB. Therefore, for backwards compatibility purposes, new systems shall accommodate JPEG images that have been labeled as using the YCC color space. Specifically, systems conformant with this standard shall accept an entry of YCC and interpret it as meaning a (device-dependent) RGB color space.

For JPEG 2000 images stored in the JP2 file format, the available enumerated color spaces are sRGB, sYCC, and grayscale. The preferred (external) color space for color images is sRGB. If a photo acquisition device uses another International Color Consortium[51] (ICC) color profile, the acquisition system shall convert the image data to one of these enumerated color spaces before the JP2 file may be embedded in a record.

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[51] See http://www.color.org/

To ensure that color images exchanged between differing systems can be correctly displayed or printed, images should be converted to the device-independent color space, sRGB, before compression or transmission to another system. As defined by IEC 61966-2-1, sRGB is a non-linear display profile that accommodates the voltage-to-color response characteristics of most high quality CRT monitors. The colors of the red, green, and blue phosphors (primaries) and the white point setting of an sRGB-conformant monitor are specified in the IEC document. For uncompressed color images containing non-interleaved red, green and blue pixels in that order, the preferred color space is sRGB.

The relationship between sRGB and a linear RGB space having the IEC-defined primaries and white point is as follows:

$$value_{sRGB} = \begin{cases} 12.92 value_{lin}, & \text{for } value_{lin} \le 0.0031308 \\ 1.055 value_{lin}^{(1/2.4)} - 0.055, & \text{for } value_{lin} > 0.0031308 \end{cases}$$

where $value_{lin}$ is an R, G, or B value in linear RGB space
(with a range of 0 to 1) and $value_{sRGB}$ is the corresponding
R, G, or B value in non-linear $sRGB$ space (also with a
range of 0 to 1). To convert from/to the range of 0 to 255,
divide/multiply by 255.

Typically, modern digital cameras, desktop scanners, LCD monitors, and printers, although they do not inherently operate in sRGB space, are designed with circuitry or software to produce sRGB output or to accommodate sRGB as an input space. If an image acquisition device's color space is unknown, sRGB is usually a reasonable choice. If an acquisition device and its software cannot provide sRGB output, various color management products are available commercially that use its color profile, often available from its manufacturer, to convert images in its native color space to sRGB.

## 7.22 Comment

The optional Comment field appears in many record types and may be used to insert free text information. It is limited to a maximum of 126 characters[52].

## 7.23 Open and closed paths

Several Record Types define open paths and polygons on an image. They are comprised of a set of vertices. For each, the order of the vertices shall be in their consecutive order along

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[52] This maximum size was established in order to maintain consistency across encodings. The maximum size differed in the 2007 and 2008 versions of the standard.

the length of the path, either clockwise or counterclockwise. A path may not have any sides crossing. No two vertices shall occupy the same position. Each vertex is expressed as an (X,Y) pair of positive integers in units of 0.01. There may be up to 99 vertices.

A closed path (polygon) completes a circuit. The closed path side defined by the last vertex and the first vertex shall complete the polygon. A polygon shall have at least 3 vertices. The contours in Record Type-17 can be a circle or ellipse[53]. A circle only requires 2 points to define it. **Field 17.033: Iris pupil boundary / IPB**, for example, uses a polygon.

An open path is a series of connected points in which there is not an implicit connection between the first point and the last point.

The Extended Feature Set used in Type-9 records was developed as a separate encoding structure that has been incorporated into this standard. In order to avoid conflicts with systems that had already programmed using the EFS method of specifying paths, that structure is retained in this standard. The vertices for paths in the Type-9 records are defined in a single information item[54].

The structure of paths fields in other Record types is as follows:

-       The first information item is dependent upon the Record Type.

  - In **Field 17.036: Lower eyelid boundary / LEB** , which is an open path, the first information item is the **Contour code / CTC**, selected from the "Code" column of **Table 14.**

  - In Record Type-17 fields (except for **Field 17.037: Other Occlusions / OOC**), the first information item is the **Path code / IPC,** with an alphabetic value selected from the "Code" column of **Table 15**.

  - For **Field 17.037: Other Occlusions / OOC**, the first information item is the **Iris occlusion opacity / IOO,** selected from the "code" column of **Table 16.**

  - For **Field 10.045: Occlusion / OCC**, the first information item is the **Face occlusion opacity / FOO,** selected from the "code" column of **Table 18.**

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[53] New to this version of the standard.

[54] In Traditional encoding, it is entered as a single string of "x1,y1-x2,y2-…-xN,yN" where xK indicates the $K^{th}$ vertex, up to the total number of vertices. A comma "," shall be entered between the X and Y coordinates of a vertex in this string, and a dash "-" shall be entered between coordinate pairs

- In **Field 14.025: Alternate finger segment position(s) / ASEG** and **Field 19.018: Friction ridge - plantar segment position(s) / FSP** the first information item contains a **Friction ridge generalized position / FGP**, an integer chosen from **Table 4.**

- In **Field 20.016: Segments / SEG** and **Field 21.016: Segments / SEG**, the first information item is the **Reference type value / RTV.** This provides a unique index to a segmentation image. When using the SOR field in other record types, this value may comprise the second (optional) information item of the SOR field.

- The second (or third in the case of **Field 20.016, Field 21.016** or **Field 17.037**) information item (**number of points / NOP)** shall specify the number of vertices.

  - For **Field 10.045: Occlusion / OCC** and **Field 17.037: Other Occlusions / OOC**, the second information item is the **Occlusion type / OCT**). It is one character containing a code from **Table 17**.

  - For **Fields 20.016 and 21.016** only, the second information item is the **internal file reference pointer text / IPT**. It is set to 0 if the source representation is a single image file. If the external file referenced in **Field 20.994: External file reference / EFR** or **Field 21.994: External file reference / EFR** is a PDF, video, or presentation file, or has multiple locations where an image may be located, this information item is the reference to the particular instance, such as page, video frame, or slide number used to derive the image transmitted in other record types. If a particular frame is chosen and there is no further image segmentation needed, the following information items shall not be used.

- The next information items are pairs of x and y coordinates of vertices. The first information item in this pairing is the **horizontal (X) pixel offset / HPO**. The second information item in this pairing is the **vertical (Y) pixel offset / VPO.** Pairings are inserted for each vertex, up to the NOP.

**Table 14: Feature Contour Code Descriptions**

| Code | Contour Description |
|---|---|
| eyetop | Bottom of upper eye lid |
| eyebottom | Top of lower eye lid |
| upperliptop | Top of upper lip |
| upperlipbottom | Bottom of upper lip |
| lowerliptop | Top of lower lip |
| lowerlipbottom | Bottom of lower lip |
| rightnostril | Subject's right nostril |
| leftnostril | Subject's left nostril |
| lefteyebrow | Curvature of top of subject's left eye socket |
| righteyebrow | Curvature of top of subject's right eye socket |
| chin | Chin |
| faceoutline | Face outline includes the entire head, all facial hair, and ears |

**Table 15: Iris boundary definition codes**

| Code | Type | Number of points | Description |
|---|---|---|---|
| C | Circle | 2 | The boundary is defined by two points: the center is defined in the first subfield, and any point on the circle is defined in the second subfield. |
| E | Ellipse | 3 | The boundary is defined by three points: both endpoints of one of the ellipse's axes are defined in the first and second subfields, and one endpoint from the other axis is defined in the third subfield. |
| P | Polygon | N (up to 99) | The boundary is defined as a n-vertex, where 'n' is between 3 and 99. The order of the vertices must be in consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. No two vertices may occupy the same location. The polygon side defined by the last subfield and the first subfield shall complete the polygon. The polygon must be asingle plane figure with no sides crossing and no interior holes. |

### Table 16: Iris occlusion opacity

| Code | Type | Description |
|------|------|-------------|
| T | Total | There is no iris detail in the area of the occlusion. |
| I | Interference | The occlusion contains interfering texture such as eyelashes or reflection. |
| L | Partial Light | There is iris detail in the area of the occlusion that is lighter than the rest of the iris. |
| S | Partial shadow | There is iris detail in the area of the occlusion that is darker than the rest of the iris. |

### Table 17: Iris occlusion type

| Code | Type | Description |
|------|------|-------------|
| L | Lashes | Eyelashes or reflections of eyelashes |
| S | Specular | Specularity, reflection of light by the iris |
| C | Shadow | Shadow cast on the iris |
| R | Reflection | Reflection of an object |
| O | Other | Any other occlusion, such as eyeglass frames blocking the image |

### Table 18 Face occlusion opacity

| Code | Type | Description |
|------|------|-------------|
| T | Total | There is no face detail in the area of the occlusion. |
| I | Interference | The occlusion contains interfering texture such as hair or reflection. |
| L | Partial light | There is face detail in the area of the occlusion that is lighter than the rest of the face. |
| S | Partial shadow | There is face detail in the area of the occlusion that is darker than the rest of the face. |

### Table 19 Face occlusion type

| Code | Type | Description |
|------|------|-------------|
| H | Head covering | Hair, hat, veil, burka, or other head covering. |
| S | Specular | Specularity, reflection of light by the face. |
| C | Cast Shadow | Shadow cast on the face. |
| R | Reflection | Reflection of an object. |
| O | Other | Any other occlusion blocking the face image. |

## 7.24 Biometric acquisition device identification

Several record types contain fields describing the biometric acquisition device[55]. The fields used are:

### 7.24.1 Device Unique Identifier / DUI

This field[56] shall contain a string uniquely identifying the device or source of the data. This data shall be one of:

    (1)    Host PC Mac address, identified by the first character "M"[57]
    (2)    Host PC processor ID, identified by the first character "P".

### 7.24.2 Make/Model/Serial Number / MAK / MOD / SER

This field contains the make, model and serial number for the capture device. It shall consist of three information items. Each information item shall be 1 to 50 characters. Any or all information items may indicate that information is unknown with the value "0".

## 7.25 Eye color

This information appears in **Field 10.027: Subject eye color / SEC** and in **Field 17.020: Eye color / ECL.** The eye color shall describe the eye color of the subject as seen in the image. If unusual or unnatural, such as is the case when colored contact lenses are present and the 'real' eye color cannot be ascertained, then the color shall be labeled as "XXX". Values for these fields shall be the alphabetic entries in the "Attribute code" column of **Table 20**.

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[55] Notice that Field 17.018 (Global unique identifier / GUI) is deprecated in this version of the standard. It did not conform to the standard GUI usage in information technology.

[56] This version of the standard deletes the options for Serial number or No serial number options from this field, since it is available in the Make / Model / Serial Number field.

[57] The MAC address takes the form of six pairs of hexadecimal digits. They are represented without separators in this standard.

**Table 20 Eye color codes**

| Eye color attribute | Attribute code |
| --- | --- |
| Black | BLK |
| Blue | BLU |
| Brown | BRO |
| Gray | GRY |
| Green | GRN |
| Hazel | HAZ |
| Maroon | MAR |
| Multicolored | MUL |
| Pink | PNK |
| Unknown | XXX |

# 8  Record Type Specifications

## 8.1  Record Type-1: Transaction information record

Record Type-1 is mandatory.  Only one Type-1 record is present per transaction.    Table 21 contains the fields associated with this Record Type.  Record Type-1 is always encoded in 7-bit US-ASCII.  See **Clause 5.5.**

**Table 21 Type-1 record layout[58]**

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 1.001 | | **RECORD HEADER[59]** | M | | | 1 | 1 |

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[58] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*"  = not defined.

[59] The Record Header content is encoding specific.  See the appropriate encoding annex for information on this field.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 1.002 | **VER** | **VERSION NUMBER** | M | N; m=4;M=4 | VER = 0500 | 1 | 1 |
| 1.003 | **CNT** | **FILE CONTENT** | M | | | 1 | 1 |
| | | *Subfield: Single set of information items* | | | | 1 | 1 |
| | REC | record category code | M | N; m=1;M=1 | REC = 1 | 1 | 1 |
| | CRC | content record count | M | N; m=1;M=3 | CRC = count of record types 2 through 99; max = 254[60] integer value | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | CRC value | CRC value |
| | REC | record category code | M⇑ | N; m=1;M=1 | $1 \leq REC \leq 10$; or $13 \leq REC \leq 21$; or = 98 or = 99 integer value | 1 | 1 |
| | IDC | information designation character | M⇑ | N; m=1;M=3 | $0 \leq IDC \leq 255$[61] integer value | 1 | 1 |
| 1.004 | **TOT** | **TYPE OF TRANSACTION** | M | A; m=1;M=16 | User-defined | 1 | 1 |

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[60] Clarification of potential ambiguities in earlier versions of the standard.

[61] Upper limit of 255 stated due to limit on IDC of one byte in Record Type-4.  This was not explicitly pointed out in earlier versions of the standard, but it was the effective upper limit.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 1.005 | **DAT** | **DATE** | M | N; m=8;M=8 | 1900≤YYYY 1≤MM≤12; 1≤DD≤31; All above are integer values DAT ≤ Today's date | 1 | 1 |
| 1.006 | **PRY** | **PRIORITY** | O | N; m=1;M=1 | 1 ≤ PRY ≤ 9 integer value | 0 | 1 |
| 1.007 | **DES**[62] | **DESTINATION AGENCY** | M | | | 1 | 1 |
| | **DAI** | destination agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **DAN** | destination agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 1.008 | **ORG**[62] | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 1.009 | **TCN** | **TRANSACTION CONTROL NUMBER** | M | N; m=1; M=* | None | 1 | 1 |
| 1.010 | **TCR** | **TRANSACTION CONTROL REFERENCE NUMBER** | O | N; m=1; M=* | None | 0 | 1 |

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[62] Note the structure.  In the 2007 version, only the Identifier was included in the field.  In the 2008 version, the optional name was added.  For consistency, the name is optional in this version.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 1.011 | **NSR** | **NATIVE SCANNING RESOLUTION** | M | N; m=5; M=5 | = 00.00 if no Type-4 or 7 records in transaction; otherwise up to xx.xx | 1 | 1 |
| 1.012 | **NTR** | **NOMINAL TRANSMITTING RESOLUTION** | M | N; m=5; M=5 | = 00.00 if no Type-4 or 7 records in transaction; otherwise xx.xx | 1 | 1 |
| 1.013 | **DOM** | **DOMAIN NAME** | O | | | 1 | 1 |
| | DNM | domain organization identifier – 1st level | M⇑ | ANS; m=1,M=* | None | 1 | 1 |
| | DVN | domain version # – 1st level | O⇑ | AN; m=1;M=* | None | 0 | 1 |
| | ONM[63] | domain organization name – 1st level | O⇑ | ANS; m=1;M=125 | None | 0 | 1 |
| | DN2[64] | domain organization identifier – 2nd level | O⇑ | ANS; m=1,M=* | None | 0 | 1 |
| | DV2[64] | domain version # – 2nd level | O⇑ | AN; m=1;M=* | None | 0 | 1 |
| | ON2[64] | domain organization name – 2nd level | O⇑ | ANS; m=1;M=125 | None | 0 | 1 |
| | DN3[64] | domain organization name – 3rd level | O⇑ | ANS; m=1,M=* | None | 0 | 1 |
| | DV3[64] | domain version # – third level | O⇑ | AN; m=1;M=* | None | 0 | 1 |
| | ON3[64] | domain organization identifier – 3rd level | O⇑ | ANS; m=1;M=125 | None | 0 | 1 |

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[63] This was in the 2008 version of the standard, but not in the 2007 version.

[64] New for this version of the standard.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | DN4[65] | domain organization name – 4th level | M⇑ | ANS; m=1,M=* | None | 0 | 1 |
| | DV4[65] | domain version # - 4th level | O⇑ | AN; m=1;M=* | None | 0 | 1 |
| | ON4[65] | domain organization identifier – 4th level | O⇑ | ANS; m=1;M=125 | None | 0 | 1 |
| 1.014 | **GMT** | **GREENWICH MEAN TIME** | O | Dependent upon encoding[66] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $GMT \leq$ Today's date and time | 0 | 1 |
| 1.015 | **DCS** | **DIRECTORY OF CHARACTER ENCODING SETS** | O | | | 0 | 1 |
| | | **Subfields: A single set of information items[67]** | | | | | |
| | CSI | character encoding set index | M⇑ | N; m=1;M=3 | $0 \leq CSI \leq 999$ integer value | 1 | 1 |

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[65] New for this version of the standard.

[66] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".

In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

[67] The 2007 version allowed multiple character encoding sets, but with XML this is not possible. To maintain consistency in encodings, only one subfield instance is now allowed.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | CSN | character encoding set name | M | ANS; m=1;M=16 | None | 1 | 1 |
| | CSV | character encoding set index | O⇑ | AN; m=1;M=16 | None | 0 | 1 |

### 8.1.1    Field 1.001 Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.1.2    Field 1.002 Version number / VER

This mandatory four-character ASCII value shall be used to specify the current version number of the standard implemented by the software or system creating the transaction. The format of this field shall consist of four numeric characters.  The first two characters shall specify the major version number.  The last two characters shall be used to specify the minor revision number. This version of the standard has the entry "0500"

### 8.1.3    Field 1.003 Transaction content / CNT

This mandatory field[68] shall list and identify each of the records in the transaction by record type and its IDC value.  It also specifies the order in which the remaining records shall appear in the file.  It shall consist of two or more subfields.  Each subfield shall contain two information items describing a single record found in the current transaction.

The first subfield shall relate to this Type-1 Transaction record.

> o       The first information item (**record category code / REC**) within this subfield  shall be "1". This indicates that the first record in the transaction is a Type-1 record consisting of header information.

> o       The second information item of this repeating subfield (**content record count / CRC)** shall be the sum of the Type-2 through Type-99 records contained

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[68] This was called file content in earlier versions of the standard.

in this transaction. This number is also equal to the count of the remaining subfields of **Field 1.003 Transaction content / CNT**.  The maximum value for CRC is 255.

Each of the remaining subfields of **Field 1.003 Transaction content / CNT** correspond to a single Type-2 through Type-99 record contained in the transaction. Two information items shall comprise each of these subfields.

> o        The first information item (**record category code / REC**), shall contain a number chosen from the "record identifier" column of **Table 1**.

> o        The second information item (**information designation character / IDC**) shall be an integer equal to or greater than zero. See **Clause 7.2**.

### 8.1.4    Field 1.004 Type of transaction / TOT

This mandatory field shall contain an identifier, which designates the type of transaction and subsequent processing that this transaction should be given. This shall be a maximum of 16 alphabetic characters. (Note:  The type of Transaction shall be in accordance with definitions provided by the receiving agency.)[69]

### 8.1.5    Field 1.005 Date / DAT

This mandatory field shall contain the local date that the transaction was initiated.   See **Clause 7.15.3.**

### 8.1.6    Field 1.006 Priority / PRY

This optional field shall contain a single information character to designate the urgency with which a response is desired.  The values shall range from 1 to 9, with 1 denoting the highest priority.  The default value shall be defined by the agency receiving the transaction.

### 8.1.7    Field 1.007 Destination agency / DES

This mandatory field shall contain the identifier of the administration or organization designated to receive the transmission.  The size and data content of this field shall be user-defined and in accordance with the receiving agency. See **Clause 7.16.**

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[69] Earlier versions of this standard specifically restricted the character length of TOT to 4 characters.

### 8.1.8    Field 1.008 Originating agency identifier / ORG

This mandatory field shall contain the identifier of the administration or organization originating the transaction.  The size and data content of this field shall be user-defined and in accordance with the receiving agency. See **Clause 7.16.**

### 8.1.9    Field 1.009 Transaction control number / TCN

This mandatory field shall contain the transaction control number as assigned by the originating agency.  A unique alphanumeric control number shall be assigned to each transaction.  For any transaction that requires a response, the respondent shall refer to this number in communicating with the originating agency.

### 8.1.10    Field 1.010 Transaction control reference / TCR

This optional field shall be used for responses that refer to the TCN of a previous transaction involving an inquiry or other action that required a response.

### 8.1.11    Field 1.011 Native scanning resolution / NSR

This mandatory field shall be set to "00.00" if there are no Type-4 records in the transaction. When there are Type-4 records present, this field is used to specify the native scanning resolution of the friction ridge image capture device. This field shall specify the resolution in pixels per millimeter. The resolution shall be expressed as two numeric characters followed by a decimal point and two more numeric characters.

If Record Type-4 is used and images are scanned at greater than the class of 500 ppi (effectively 510 ppi), they shall be subsampled, scaled down, or interpolated down to produce a class resolution of 500 ppi for transmission. Users are required to use Record Type-14 if transmitting a fingerprint image at greater than 20.08 ppmm (510 ppi)[70].  Images with scanning resolution greater than or equal to the 1000 ppi class shall not be transmitted using Record Type-4[70]. An appropriate Record Type above 9 shall be used if scanning an other image at greater than the upper limit of 99.99 ppmm (2540 ppi) , rather than using a Type-7 record. See **Clause 7.14.2**.

### 8.1.12    Field 1.012 Nominal transmitting resolution / NTR

This mandatory field shall be set to "00.00" if there are no Type-4 records in the transaction. When there are Type-4 or Type-7 records present, this field specifies the nominal resolution for the image(s) being exchanged. This field shall specify the transmitting resolution in

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[70] Clarification of potential ambiguities in earlier versions of the standard.

pixels per millimeter. The transmitting resolution shall be within the range 19.30 ppmm (490 ppi) to 20.08 ppmm (510 ppi).  For example, a sensor that scans natively at 508ppi would list both NSR and NTR as 20ppmm (=508ppi). These images should not be sampled down to exactly 500ppi.[71] See **Clause 7.14.3.**

### 8.1.13   Field 1.013 Domain name / DOM

This optional field identifies the domain name for the user-defined Type-2 record implementation.  The domain name may only appear once within a transaction.  It shall consist of one or two information items.  See **Clause 6.**

- The mandatory first information item (**organization identifier / DNM**) will uniquely identify the agency, entity, or implementation used for formatting the fields in the Type-2 record. The default value for the field shall be the North American Domain implementation (NORAM).

- An optional second information item (**domain version number / DVN**) shall contain the unique version of the particular implementation, such as 7.02.

- An optional third information item (**organization name / ON1**) shall contain the organization's name.

  There may be three more optional triads of information items, with the same format as those described above.  They are used when a transmission is conformant with more than one domain specification, such as NORAM, and Texas DPS (Department of Public Safety). See **Table 21** for the information item names.

### 8.1.14   Field 1.014 Greenwich Mean Time / GMT

This optional field provides a mechanism for expressing the date and time in terms of universal Greenwich Mean Time (GMT) units.  See **Clause 7.15.2.**

### 8.1.15   Field 1.015 Directory of character encoding sets / DCS

This optional field is a directory or list of character encoding sets other than 7-bit ASCII that may appear within this transaction.  This field shall contain one set of information items[72] with at least two information items and an optional third information item. For a description of the use of alternate character encoding sets see **Clause 5.5.**

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[71] Clarification of potential ambiguities in earlier versions of the standard.

[72] This is consistent with the 2008 version of the standard.  The 2007 version allowed multiple character encoding sets.

· The first information item in each repeating subfield (**character encoding set index / CSI**) is the three-character identifier for the set index number that references an associated character encoding set that may used in other Record Types. See the "Character encoding set index" column of **Table 2** for the valid values for this information item.

· The second information item in the repeating subfield (**character encoding set name / CSN**) shall be the "Character encoding set name" for the character encoding set associated with that index number, taken from **Table 2**.

· The optional third information item (**character encoding set version / CSV**) is the specific version of the character encoding set used. In the case of the use of UTF-8, the third optional information item may be used to hold the specific version used, so that the display terminal can be switched to the correct font family.

## 8.2    Record Type-2: User-defined descriptive text record

Type-2 records are optional, but when present, shall contain textual information relating to the subject of the transaction. This record may include such information as the state or FBI numbers, physical characteristics, demographic data, and the subject's criminal history. Every transaction usually contains one or more Type-2 records which is dependent upon the entry in **Field 1.004 Type of transaction / TOT.** More than one Type-2 record may be included in the transaction.

**Table 22 Type-2 record layout[73]**

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 2.001 | | RECORD HEADER[74] | M | | | 1 | 1 |
| 2.002 | IDC | INFORMATION DESIGNATION CHARACTER | M⇑ | N; m=1;M=3 | $0 \leq IDC \leq 255$ integer value | 1 | 1 |
| 2.003 and above | USER-DEFINED | USER-DEFINED FIELDS | O | User-defined | | User-defined | User-defined |

### 8.2.1 Field 2.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.2.2 Field 2.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-2 record as found in the IDC in **Field 1.003 Transaction content / CNT**. See **Clause 7.2.**

### 8.2.3 Fields 2.003 and above: User defined fields

Individual fields shall conform to the specifications set forth by the agency to which the transmission is being sent and to the requirements specified in **Clause 5.1.**

## 8.3 Record Type- 3: DEPRECATED

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for the specifications of this Record Type.

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[73] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[74] The Record Header content is encoding specific. See the appropriate encoding annex for information on this field.

## 8.4 Record Type- 4: Grayscale fingerprint image (old format)

The Type-4 record is based on the use of a captured fingerprint image obtained using a class scanning resolution of 500 ppi. (See **Clause 7.14).** Record Type-4 cannot be updated to include new fields, since the Traditional encoding for this record type is fixed in length and order[75].

**Table 23 Type-4 record layout[76]**

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 4.001 | | RECORD HEADER[77] | M | | | 1 | 1 |
| 4.002 | IDC | INFORMATION DESIGNATION CHARACTER | M⇑ | N; XML only: m=1;M=3 Traditional = 1 byte | $0 \leq IDC \leq 255$[78] integer value | 1 | 1 |

[75] Note that the Traditional encoding for this record type includes binary (not text) representations of the data.

[76] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[77] The Record Header content is encoding specific. See the appropriate encoding annex for information on this field.

[78] This was implicit in previous versions of the standard, but not explicitly stated.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 4.003 | **IMP** | **IMPRESSION TYPE** | M | N; XML only: m=1;M=2 <br> Traditional = 1 byte | $0 \leq IMP \leq 3$ or <br> IMP = 8 or <br> $20 \leq IMP \leq 29$ <br> integer value | 1 | 1 |
| 4.004 | **FGP** | **FRICTION RIDGE GENERALIZED POSITION** | M | N; XML only: m=1;M=3 <br> Traditional = 6 bytes | $0 \leq FGP \leq 15$ or[79] <br> FGP = 19 or239 <br> $40 \leq FGP \leq 50$ or[80] <br> FGP = 255 <br> integer value | 6 | 6 |
| 4.005 | **ISR** | **IMAGE SCANNING RESOLUTION** | M | N; XML only: m=1;M=1 <br> Traditional = 1 byte | ISR = 0 or 1 <br> integer value | 1 | 1 |
| 4.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; XML only: m=2 ; M=5 <br> Traditional = 2 bytes | $10 \leq HLL \leq 65534$ <br> integer value | 1 | 1 |
| 4.007 | **VLL** | **VERTICAL LINE LENGTH** | M | N; XML only: m=2; M=5 <br> Traditional format = 2 bytes | $10 \leq VLL \leq 65534$ <br> integer value | 1 | 1 |
| 4.008 | **GCA / BCA** | **COMPRESSION ALGORITHM** | M | N; XML only: m=1;M=1 <br> Traditional format = 1 byte | $0 \leq value \leq 6$ <br> integer value | 1 | 1 |
| 4.009 | **DATA** | **IMAGE DATA** | M | B; m=1; M=* | None | 1 | 1 |

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[79] In both the 2007 and 2008 versions of the standard.

[80] New for this version of the standard (update to reflect ANSI/NIST-ITL 1a-2009).

### 8.4.1 Field 4.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.4.2 Field 4.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-4 record as found in the information item IDC of **Field 1.003 Transaction content / CNT**. See **Clause 7.2.**

### 8.4.3 Field 4.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint was obtained. See **Clause 7.9** for details.

### 8.4.4 Field 4.004: Friction ridge generalized position / FGP

This mandatory field shall contain the decimal code number corresponding to the finger position and shall be taken from **Table 4** (only finger numbers 0-15, 19, and 40-50 apply to Type-4). Up to five additional finger positions shall be referenced by entering the alternate finger positions using the same format. If fewer than five finger position references are to be used, the unused position references shall be filled with 255. Six values shall be entered in each record. See **Clause 7.10** for more information.

### 8.4.5 Field 4.005: Image scanning resolution / ISR

This mandatory field shall contain a 0 if the transmitted image resolution is recorded in **Field 1.012 Nominal transmitting resolution / NTR**. The field shall contain a 1 if the transmitted image uses native scanning resolution, recorded in Field 1.011 (NSR), which is above the allowed NTR range of 490 ppi to 510 ppi. If Record Type-4 is used and images are scanned at a step in the migration path greater than the class of 500 ppi (effectively 510 ppi) , they shall be subsampled, scaled down, or interpolated down to produce a class resolution of 500 ppi for transmission. Users are required to use Record Type-14 if transmitting a fingerprint image at greater than 20.08 ppmm (510 ppi)[81]. See **Clause 7.14.2.**

### 8.4.6 Field 4.006: Horizontal line length / HLL

This mandatory field shall contain the number of pixels on a single horizontal line of the transmitted image. See **Clause 7.19.**

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[81] Clarification of potential ambiguities in earlier versions of the standard.

### 8.4.7    Field 4.007: Vertical line length / VLL

This mandatory field shall contain the number of pixels on a single horizontal line of the transmitted image. . See **Clause 7.19.**

### 8.4.8    Field 4.008: Compression algorithm / CGA / BCA

This is a mandatory field. It shall be used to specify the type of compression algorithm used (if any).  A zero denotes no compression.  Otherwise, the contents shall be a number allocated to the particular compression technique used by the interchange parties.  The specific code for each algorithm can be found in **Table 12** or from the domain registrar who will maintain a registry relating these numbers to the compression algorithms.  See **Clause 7.20.1**.

### 8.4.9    Field 4.009: Image data / DATA

This is a mandatory field. Each pixel of the uncompressed grayscale image shall be quantized to eight bits (256 gray levels) contained in a single byte.  For the exchange of an uncompressed binary image, eight pixels shall be left justified and packed into a single unsigned byte.  The most significant bit of the byte shall be the first of the eight pixels scanned.  If compression is used, the pixel data shall be compressed in accordance with the compression technique specified in the GCA / BCA field.

## 8.5   Record Type-5: Deprecated

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for the specifications of this Record Type.

## 8.6   Record Type-6: Deprecated

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for the specifications of this Record Type.

## 8.7   Record Type-7: User-defined image record

Type-7 records shall contain user-defined image information relating to the transaction submitted for processing[82].  Users are discouraged from utilizing this Record Type;  new implementations based on this standard should use the Record Type-13 records for latent records, and other record types, as appropriate, for transmitting biometric and forensic images. Images transmitted using Record Type-7 shall consist of scanned pixels that may

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[82] Note that the Traditional encoding for this record type includes binary (not text) representations of the data.

be either binary or grayscale output.  Each grayscale pixel value shall be expressed as an unsigned byte. A value of 0 shall be used to define a black pixel and an unsigned value of 255 shall be used to define a white pixel.  For binary pixels, a value of 0 shall represent a white pixel and a value of 1 shall represent a black pixel.  If compression is used, the algorithm shall be the same as that specified for Type-4 logical records.

**Table 24 Type-7 record layout[83]**

| Field Number | Mnemonic | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 7.001 | | RECORD HEADER[84] | M | | | 1 | 1 |
| 7.002 | IDC | INFORMATION DESIGNATION CHARACTER | M⇑ | N; XML only: m=1;M= 3 Traditional format = 1 byte | $0 \le IDC \le 255$ integer value[85] | 1 | 1 |
| Additional Fields | USER-DEFINED | USER-DEFINED | User-defined | User-defined | User-defined | User-Defined | User-Defined |

#### 8.7.1    Field 7.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

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[83]  Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*"  = not defined.

[84] The Record Header content is encoding specific.  See the appropriate encoding annex for information on this field.

[85] This was implicit in previous versions of the standard, but not explicitly stated.

### 8.7.2 Field 7.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-7 record as found in the information item IDC of **Field 1.003 Transaction content / CNT**. See **Clause 7.2.**

### 8.7.3 Fields 7.003 through 7.999: User-defined fields

The remaining fields of the Type-7 record shall be user-defined. Individual fields shall conform to the specifications of the agency to which the transmission is being sent.

## 8.8 Record Type-8: Signature image record

Type-8 records[86] shall contain either scanned or vectored signature data, covering an area of up to 1000 mm$^2$. Two signature image records (from the operator and the subject) are allowed per transaction. See **Clause 7.14** for resolution information.Vectored signature data shall be expressed as a series of numbers

**Table 25 Type-8 record layout[87]**

| Field Number | Mnemonic | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 8.001 | | RECORD HEADER[88] | M | | | 1 | 1 |

---

[86] Note that the Traditional encoding for this record type includes binary (not text) representations of the data.

[87] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64.

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[88] The Record Header content is encoding specific. See the appropriate encoding annex for information on this field.

| Field Number | Mnemonic | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 8.002 | IDC | INFORMATION DESIGNATION CHARACTER | M | N; XML only: m=1;M= 3 Traditional format = 1 byte | $0 \leq IDC \leq 255$ integer value[89] | 1 | 1 |
| 8.003 | SIG | SIGNATURE TYPE | M | N; XML only: m=1;M=1 Traditional format = 1 byte | SIG = 0 or 1 integer value | 1 | 1 |
| 8.004 | SRT | SIGNATURE REPRESENTATION TYPE | M | N; XML only: m=1;M=1 Tradition format = one byte | IF SIG = 0, SRT = 0 or 1; IF SIG = 1, SRT = 2 integer value | 1 | 1 |
| 8.005 | ISR | IMAGE SCANNING RESOLUTION | M | N; XML only: m=1;M=1 Traditional format = 1 byte | ISR = 0 or 1 | 1 | 1 |
| 8.006 | HLL | HORIZONTAL LINE LENGTH | M | N; XML only: m=2; M=5 Traditional format = 2 bytes | HLL = 0 or $10 \leq HLL \leq 65534$ integer value[89] | 1 | 1 |
| 8.007 | VLL | VERTICAL LINE LENGTH | M | N; XML only: m=2; M=5 Traditional format = 2 bytes | VLL = 0 or $10 \leq VLL \leq 65534$ integer value[89] | 1 | 1 |
| 8.008 | DATA | SIGNATURE DATA | M | Dependent upon value of SIG | | 1 | 1 |

[89] This was implicit in previous versions of the standard, but not explicitly stated.

### 8.8.1 Field 8.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.8.2 Field 8.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-8 record as found in the information item IDC of **Field 1.003 Transaction content / CNT**. See **Clause 7.2.**

### 8.8.3 Field 8.003: Signature type / SIG

This mandatory field shall contain 0 for the signature image of the subject, or 1 for the signature image of the official processing the transaction.

### 8.8.4 Field 8.004: Signature representation type / SRT

This mandatory field shall be 0 if the image is scanned and not compressed, a 1 if the image is scanned and compressed, and 2 if the image is vector data.

### 8.8.5 Field 8.005: Image scanning resolution / ISR

This mandatory field shall contain 0 if the transmitted image resolution is recorded in **Field 1.012 Nominal transmitting resolution / NTR**. The field shall contain 1 if the transmitted image uses native scanning resolution, recorded in **Field 1.011 Native scanning resolution / NSR**, which is above the allowed NTR range. A value of 0 shall also be used if the image is vector data.

### 8.8.6 Field 8.006: Horizontal line length / HLL

This mandatory field shall be used to specify the number of pixels contained on a single horizontal line of the transmitted signature image. For vectored signature data, the value shall be zero. See **Clause 7.19.**

### 8.8.7 Field 8.007: Vertical line length / VLL

This mandatory field shall be used to specify the number of horizontal lines contained in the transmitted signature image. For vectored signature data, the value shall be zero. See **Clause 7.19.**

### 8.8.8 Field 8.008: Signature image data / DATA

This mandatory field shall contain uncompressed scanned image signature data, compressed scanned image signature data, or vectored image signature data. The entry contained in the SRT field shall indicate which form of the signature data is present.

### 8.8.8.1 Uncompressed scanned image data

If the SRT field contains the value of zero, then this field shall contain the uncompressed scanned binary image data for the signature. In uncompressed mode, the data shall be packed at eight pixels per byte.

### 8.8.8.2 Compressed scanned image data

If the SRT field contains the value of one, then this field shall contain the scanned binary image data for the signature in compressed form using the *ANSI/EIA-538-1988 facsimile compression algorithm*.

### 8.8.8.3 Vectored image data

If the SRT field contains the value of two, then this field shall contain a list of vectors that describes the pen position. Each vector has three parts:

- · The first part is a horizontal (X) coordinate value.
- · The second part is a vertical (Y) coordinate value.
- · The third part is the pen pressure value of line segments within the signature.

Both the X and Y coordinates shall be expressed in units of .0254 mm (.001 inches) referenced from the bottom leftmost corner of the signature. Positive values of X shall increase from left-to-right and positive values of Y shall increase from bottom-to-top.

The pen pressure shall be a constant value until the next vector becomes active. A value or pressure of 0 shall represent a "pen-up" (or no pressure) condition. The value of 1 shall represent the least recordable pressure for a particular device, while 254 shall represent the maximum recordable pressure for that device. To denote the end of the vector list, 255 shall be inserted in this entry.

## 8.9 Record Type-9: Minutiae data record

Type-9 records shall contain text describing minutiae and related information encoded from a finger, palm, or plantar image. There is no limit on the number of Type-9 records for a latent search transaction. The Type-9 record shall also be used to exchange minutiae and related information from latent friction ridge images between similar or different systems.

Note that **Fields 9.005 through 9.012** have been deprecated in this version of the standard for all new applications. For users encountering these fields in legacy systems, please refer to *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for a description of those fields. Old records may still be transmitted in a transaction conformant to the this version of the standard.

Reserved blocks, each consisting of several fields, are registered and allocated for use by specific vendors. As these blocks may contain proprietary information, no detailed information is provided regarding the content of these vendor-defined feature sets aside from the range of field numbers in this standard. For detailed information on each of these fields, the vendor shall be contacted. These alternative blocks of reserved fields allow vendors to encode minutiae data and any additional required characteristic or feature data in accordance with their own system's specific hardware and software configuration. **Table 26** identifies the vendor implementations and their assigned blocks of field numbers. For those vendors not identified or identified in the table, **Fields 9.176** through **9.225** may be used to record their proprietary features[90].Any vendor may use these fields to record information. The name of the vendor or developer of the proprietary feature data, the name and version of the algorithm used, the target device for which the data is generated, and the contact information, together with the feature data shall be recorded within this block of fields.

Record **Fields 9.126** through **9.150** correspond to the conventions defined and described originally by the *ANSI INCITS 378-2004* standard.

Record **Fields 9.300** through **9.398** are the Extended Feature Set[90].

All fields of the Type-9 records shall be recorded as text. Although this record type may also be used to accommodate a variety of methods used by different AFIS vendors for encoding minutiae data according to their particular requirements, each vendor implementation shall contain the first four fields described below.  Fields corresponding to the *M1-378 / ISO 19794-2* features, the Extended Feature Set and the Universal Latent annotation[90] may be used with or without the fields associated with registered implementations.

In the 2008 version of the standard, only one vendor block (including the M1 format) could be present in a single record.  The 2007 version allowed multiple blocks to be present.  The 2011 version is consistent with the 2007 version for all encodings --  allowing multiple blocks (including the M1 block and the EFS block) to be present.

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[90]New for this version of the standard.

## Table 26 Type-9 record layout[91]

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 9.001 | | **RECORD HEADER**[92] | M | | | 1 | 1 |
| 9.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$ integer value[93] | 1 | 1 |
| 9.003 | **IMP** | **IMPRESSION TYPE** | M | N; m=1;M=2 | $0 \leq IMP \leq 15$ or $20 \leq IMP \leq 35$[94] integer value | 1 | 1 |
| 9.004 | **FMT** | **MINUTIA FORMAT** | M | A; m=1;M=1 | FMT = U (S if including fields 9.005-9.012 from old record sources) | 1 | 1 |
| 9.005-9.012 | | **Deprecated; See ANSI/NIST-ITL 1-2007 for a description of these fields** | | | | | |
| 9.013-9.030 | | **FBI IAFIS FEATURE SET** | | | | | |
| 9.031-9.055 | | **COGENT (3M) FEATURE SET** | | | | | |

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[91] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[92] The Record Header content is encoding specific. See the appropriate encoding annex for information on this field.

[93] Clarification of potential ambiguities in earlier versions of the standard.

[94] Extended to include plantar impressions (new for this version of the standard).

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 9.056-9.070 | | MOTOROLA (SAGEM) FEATURE SET | | | | | |
| 9.071-9.099 | | SAGEM MORPHO (SAGEM) FEATURE SET | | | | | |
| 9.100-9.125 | | NEC FEATURE SET | | | | | |
| 9.126-9.150 | | M1-378 FIELDS (See Table 27) | | | | | |
| 9.151-9.175 | | IDENTIX FEATURE SET | | | | | |
| 9.176 | ODD | OTHER FEATURE SET OWNER OR DEVELOPER[95] | O | ANS; m=1; M=40 | None | 0 | 1 |
| 9.177 | PAG | OTHER FEATURE SET PROCESSING ALGORITHM[95] | C-ODD | ANS; m=1; M=40 | None | 0 | 1 |
| 9.178 | SOD | OTHER VENDOR SET SYSTEM OR DEVICE[95] | C-ODD | ANS; m=1; M=40 | None | 0 | 1 |
| 9.179 | DTX | OTHER FEATURE SET DESCRIPTIVE TEXT[95] | C-ODD | ANS; m=1; M=100 | None | 0 | 1 |
| 9.180-9.225 | OFS | OTHER FEATURE SET DEFINED FIELDS[95] | C-ODD | User-defined | User-defined | 0 | 1 |
| 9.226-9.299 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 9.300-9.399 | | EXTENDED FEATURE SET (See Table 28) [95] | | | | | |
| 9.400-9.900 | RSV | RESERVED FOR FUTURE USE | | | | | |

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[95] New for this version of the standard.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 9.901 | **LAI** | **UNIVERSAL LATENT ANNOTATION**[96] | O | | | 0 | 1 |
| | | *Subfield: repeating values* | M⇑ | ANS; m= 22; M=300 | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integers; remainder of the subfield is concatenated as free text.  Each entry is a different value. | 1 | Unlimited |
| 9.902 | **ANN** | **ANNOTATED INFORMATION**[96] | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |

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[96] New for this version of the standard.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[97] | $1900 \leq YYYY$<br>$1 \leq MM \leq 12$;<br>$1 \leq DD \leq 31$<br>$0 \leq hh \leq 23$<br>$0 \leq mm \leq 59$<br>$0 \leq ss \leq 59$<br>All above are integer values<br>GMT $\leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or latent workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 9.903-9.999 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

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[97] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

## Table 27 Type-9 Fields for M1-378 features

Note: The condition codes in this table apply if the block of features is present.  The entire block may be absent from a transaction.  Thus, mandatory, indicates 'mandatory if this block of records is present.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 9.126 | **CBI** | **CBEFF INFORMATION** | M | | | 1 | 1 |
| | CFO | CBEFF format owner | M | N; m=2; M=2 | CFO = 27 | 1 | 1 |
| | CFT | CBEFF format type | M | N; m=3; M=3 | CFT = 513 or 514 | 1 | 1 |
| | CPI | CBEFF product identifier | M | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| 9.127 | **CEI** | **CAPTURE EQUIPMENT ID** | M | | | 1 | 1 |
| | AFS | appendix F status | M | A; m=4; M=4 | AFS = APPF or NONE | 1 | 1 |
| | CEI | capture equipment ID | M | ANS; m=1; M=30 | None ( 0 = unreported) | 1 | 1 |
| 9.128 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; m=2; M =5 | $10 \le HLL \le 99999$ integer number | 1 | 1 |
| 9.129 | **VLL** | **VERTICAL LINE LENGTH** | M | N; m=2; M =5 | $10 \le VLL \le 99999$ integer number | 1 | 1 |

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 9.130 | **SLC** | **SCALE UNITS** | M | N; m=1; M=1 | SLC = 1 or 2 | 1 | 1 |
| 9.131 | **HPS** | **HORIZONTAL PIXEL SCALE** | M | N; m=1; M=4 | positive integer | 1 | 1 |
| 9.132 | **VPS** | **VERTICAL PIXEL SCALE** | M | N; m=1; M=4 | positive integer | 1 | 1 |
| 9.133 | **FVW** | **FINGER VIEW** | M | N; m=1; M=2 | $0 \leq FVW \leq 15$ integer value | 1 | 1 |
| 9.134 | **FGP** | **FRICTION RIDGE GENERALIZED POSITION** | M | N; m=1; M=2 | $0 \leq FGP \leq 10$ integer value[98] | 1 | 1 |
| 9.135 | **FQD** | **FRICTION RIDGE QUALITY DATA** | M | | | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[99] |
| | QVU | quality value | M | N; m=1; M=3 | $0 < QVU < 100$ or $QVU = 254$ or $QVU = 255$ integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 9.136 | **NOM** | **NUMBER OF MINUTIAE** | M | N; m=1; M=4 | $1 \leq NOM \leq 9999$[100] integer value | 1 | 1 |

[98] The 2007 version was restricted to fingerprints. The 2008 version included the ability to encode palm prints in this block. However, since the M1 standard refers only to fingerprints, the set of codes is restricted to fingerprints, (like the 2007 version) for this version.

[99] For consistency, this version allows a maximum of 9 algorithms in all encodings for quality fields in all record types.

[100] No upper limit was specified in previous versions. This value is sufficient to allow for plantars.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 9.137 | **FMD** | **FINGER MINUTIAE DATA** | M | | | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | NOM |
| | MAN | minutia index number | M | N; m= 1; M = 4 | $1 \leq MAN \leq NOM$ integer value | 1 | 1 |
| | MXC | X coordinate | M | N; m=1; M = 5 | $1 \leq MXC \leq HLL$ integer value | 1 | 1 |
| | MYC | Y coordinate | M | N; m=1; M = 5 | $1 \leq MYC \leq VLL$ integer value | 1 | 1 |
| | MAV | minutia angle | M | N; m= 1; M=3 | $1 \leq MAV \leq 179$ integer value | 1 | 1 |
| | MTY | minutia type | M | N; m=1; M=1 | MTY = 0, 1 or 2 | 1 | 1 |
| | QOM | quality of minutia | M | N; m=1; M=3 | $0 \leq QOM \leq 100$ integer value | 1 | 1 |
| 9.138 | **RCI** | **RIDGE COUNT INFORMATION**[101] | O | | | 0 | 1 |
| | | *Subfield: Set of information items* | | | | 1 | 1 |
| | REM | ridge count extraction method | M⇑ | N; m=1; M=1 | REM = 0, 1 or 2 | 1 | 1 |
| | FI1 | filler 1 | M⇑ | N; m=1; M =1 | FI1 = 0 | 1 | 1 |
| | FI2 | filler 2 | M⇑ | N; m=1; M =1 | FI2 = 0 | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 8 * NOM |

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[101] Note that the first subfield is in the same format as following subfields.

| Field Number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | CMI | center minutia index number | M | N; m=1; M= 4 | $1 \leq CMI \leq NOM$ integer value | 1 | 1 |
| | NMN | neighboring minutia index number | M | N; m=1; M= 4 | $1 \leq NMN \leq NOM$ integer value | 1 | 1 |
| | NRC | number of ridges crossed | M | N; m=1; M= 2 | $1 \leq NRC \leq 99$ integer value | 1 | 1 |
| | **CIN** | **CORE INFORMATION** | O | | | | |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9 |
| | XCC | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq XCC \leq HLL$ integer value | 1 | 1 |
| | YCC | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq YCC \leq VLL$ integer value | 1 | 1 |
| | AOC | angle of the core | M⇑ | N; m=1; M=3 | $1 \leq AOC \leq 179$ integer value | 1 | 1 |
| | **DIN** | **DELTA INFORMATION** | O | | | | |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9 |
| | XCD | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq XCD \leq HLL$ integer value | 1 | 1 |
| | YCD | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq YCD \leq VLL$ integer value | 1 | 1 |
| | AOD | angle of the delta | M⇑ | N; m=1; M=3 | $1 \leq AOD \leq 179$ integer value | 1 | 1 |

## Table 28 Type-9 Fields for the Extended Feature Set[102]

Note: The condition codes in this table apply if the block of features is present.  The entire block may be absent from a transaction.  Thus, mandatory, indicates 'mandatory if this block of records is present.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 9.300 | **ROI** | **REGION OF INTEREST** | M | | | 1 | 1 |
| | EWI | ROI width | M | N; m = 1; M=5 | $1 \leq EWI \leq 50000$ integer value | 1 | 1 |
| | EHI | ROI height | M | N; m = 1; M=5 | $1 \leq EHI \leq 50000$ integer value | 1 | 1 |
| | EHO | ROI horizontal offset | O | N; m = 1; M=5 | $1 \leq EHO \leq 50000$ integer value | 0 | 1 |
| | EVO | ROI vertical offset | O | N; m = 1; M=5 | $1 \leq EVO \leq 50000$ integer value | 0 | 1 |
| | ROP | ROI vertices | O | NS; m=11; M=1188 | None | 0 | 1 |
| 9.301 | **ORT** | **ORIENTATION** | O | | | 0 | 1 |
| | EOD | Direction | M⇑ | NS; m=1; M=4 | $-179 \leq EOD \leq 180$ integer value | 1 | 1 |
| | EUC | Uncertainty | O⇑ | N; m=1; M=3 | $0 \leq EUC \leq 180$ integer value | 0 | 1 |
| 9.302 | **FPP** | **FINGER, PALM, PLANTAR POSITION** | M | | | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 20 |

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[102] New for this version of the standard

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | FGP | friction ridge generalized position | M | N; m=1; M=2 | 1 < FGP < 12 or 19 < FGP < 38 or 60 < FGP < 77 integer value | 1 | 1 |
| | FSM | finger segment | O | A; m=3; M=3 | FSM = DST, PRX, MED or UNK | 0 | 1 |
| | OCF | off-center fingerprint | O | A; m=1; M=1 | OCF = T, R or L | 0 | 1 |
| | SGP | segment polygon | O | NS; m=11; M=1188 | None | 0 | 1 |
| 9.303 - 9.306 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.307 | **PAT** | **PATTERN CLASSIFICATION** | C- finger-prints only | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 7 |
| | GCF | general class | M⇑ | A; m=2; M=2 | Values from **Table 30** | 1 | 1 |
| | SUB | subclass | C-GCF | A; m=2; M=2 | Values from **Table 30** | 0 | 1 |
| | WDR | whorl-delta relationship | C-GCF | A; m=1; M=1 | WDR = I, O or M | 0 | 1 |
| 9.308 | **RQM** | **RIDGE QUALITY MAP** | | | | 0 | 1 |
| | | *Subfields: Repeating values (one entry for each row)* | M⇑ | AN; m=1; M=100000 | Individual characters are 1,2,3,4,5, A,B,C,D,E, or F | 1 | EHI/GSZ+1 |
| 9.309 | **RQF** | **RIDGE QUALITY MAP FORMAT** | C-RQM | | | 0 | 1 |
| | GSZ | grid size | M⇑ | N; m=1; M=2 | $1 \leq GSZ \leq 41$ integer value | 1 | 1 |
| | RDF | ridge quality data format | M⇑ | A; m=3; M=3 | RDF = UNC or RLE | 1 | 1 |
| 9.310 | **RFM** | **RIDGE FLOW MAP** | O | | | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | | *Subfields: Repeating values* *(one entry for each row)* | M⇑ | AN; m=1; M=100000 | Valid Base64 or Hex values | 1 | EHI/SFQ+1 |
| 9.311 | **RFF** | **RIDGE FLOW MAP FORMAT** | C-RFM | | | 0 | 1 |
| | SFQ | sampling frequency | M⇑ | N; m=1; M=2 | $1 \leq SFQ \leq 41$ integer value | 1 | 1 |
| | RDF | ridge flow data format | M⇑ | AN; m=3; M=3 | RDF = UNC or B64 | 1 | 1 |
| 9.312 | **RWM** | **RIDGE WAVELENGTH MAP** | O | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | AN; m=1; M=100000 | 2 digit positive integer value < 99 or XX | 1 | EHI/FWS+1 |
| 9.313 | **RWF** | **RIDGE WAVELENGTH MAP FORMAT** | C-RWM | | | 0 | 1 |
| | FWS | sampling frequency | M⇑ | N; m=1; M=2 | $1 \leq FWS \leq 41$ integer value | 1 | 1 |
| | FDF | data format | M⇑ | A; m=3; M=3 | = UNC | 1 | 1 |
| 9.314 | **TRV** | **TONAL REVERSAL** | O | A; m=1; M=1 | TRV = N or P | 0 | 1 |
| 9.315 | **PLR** | **POSSIBLE LATERAL REVERSAL** | O | A; m=1; M=1 | PLR = L or U | 0 | 1 |
| 9.316 | **FQM** | **FRICTION RIDGE QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[103] |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ integer value or QVU = 254 or 255 | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |

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[103] This upper limit has been stated in this version to maintain consistency across all encodings and record types.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | 1≤ QAP ≤ 65534 integer value | 1 | 1 |
| 9.317 | **PGS** | **POSSIBLE GROWTH OR SHRINKAGE** | O | | | 0 | 1 |
| | TGS | growth or shrinkage type | M⇑ | A; m=1; M=1 | TGS = G, S or B | 1 | 1 |
| | CGS | growth or shrinkage comment | M⇑ | ANS; m=1; M=1000 | None | 1 | 1 |
| 9.318-9.319 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.320 | **COR** | **CORES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 15 |
| | CXC | X coordinate | M⇑ | N; m=1; M=5 | 1≤ CXC ≤ EWI | 1 | 1 |
| | CYC | Y coordinate | M⇑ | N; m=1; M=5 | 1≤ CYC ≤ EHI | 1 | 1 |
| | CDI | direction | O⇑ | N; m=1; M=3 | -179 ≤ CDI ≤ 180 | 0 | 1 |
| | RPU | radius of position uncertainty | O⇑ | N; m=1; M=3 | 1 ≤ RPU ≤ 999 | 0 | 1 |
| | DUY | direction uncertainty | O⇑ | N; m=1; M=3 | 0 ≤ DUY ≤ 359 integer value | 0 | 1 |
| 9.321 | **DEL** | **DELTAS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 15 |
| | DXC | X coordinate | M⇑ | N; m=1; M = 5 | 1≤ DXC ≤ EWI | 1 | 1 |
| | DYC | Y coordinate | M⇑ | N; m=1; M = 5 | 1≤ DYC ≤ EHI | 1 | 1 |
| | DUP | direction up | O⇑ | N; m=1; M=3 | 0 ≤ DUP ≤ 180 | 0 | 1 |
| | DLF | direction left | O⇑ | N; m=1; M=3 | 0 ≤ DLF ≤ 180 | 0 | 1 |
| | DRT | direction right | O⇑ | N; m=1; M=3 | 0 ≤ DRT ≤ 180 | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 9.322 | **CDR** | **CORE-DELTA RIDGE COUNTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 225 |
| | CIX | core index | M⇑ | AN; m=1; M=2 | $1 \leq CIX \leq 99$ integer value or CIX = L or U | 1 | 1 |
| | DIX | delta index | M⇑ | AN; m=1; M=2 | $1 \leq DIX \leq 99$ integer value or DIX = L or R | 1 | 1 |
| | MRC | min ridge count | M⇑ | N; m=1; M=2 | $1 < MRC < 99$ integer value | 1 | 1 |
| | XRC | max ridge count | O⇑ | N; m=1; M=2 | $1 < XRC < 99$ integer value | 0 | 1 |
| 9.323 | **CPR** | **CENTER POINT OF REFERENCE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 3 |
| | CMP | method | M⇑ | AN; m=1; M=1 | CMP = L or 0 or 1 | 1 | 1 |
| | PXC | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq PXC \leq EWI$ integer value | 1 | 1 |
| | PYC | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq PYC \leq EHI$ integer value | 1 | 1 |
| | RPU | radius of position uncertainty | O⇑ | N; m=1; M=3 | $1 \leq RPU \leq 999$ | 0 | 1 |
| 9.324 | **DIS** | **DISTINCTIVE FEATURES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 99 |
| | DIT | distinctive feature type | M⇑ | A; m=4; M=10 | Entries from **Table 40** | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | DFP | distinctive features polygon | O⇑ | NS; m=11; M=1188 | None | 0 | 1 |
| | DFC | distinctive features comment | O⇑ | AN; m=1; M=1000 | None | 0 | 1 |
| 9.325 | **NCR** | **NO CORES PRESENT** | O | A; m=1; M=1 | NCR = Y | 0 | 1 |
| 9.326 | **NDL** | **NO DELTAS PRESENT** | O | A; m=1; M=1 | NDL = Y | 0 | 1 |
| 9.327 | **NDF** | **NO DISTINCTIVE FEATURES PRESENT** | O | A; m=1; M=1 | NDF = Y | 0 | 1 |
| 9.328-9.330 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.331 | **MIN** | **MINUTIAE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 999 |
| | MXC | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq MXC \leq EWI$ integer value | 1 | 1 |
| | MYC | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq MYC \leq EHI$ integer value | 1 | 1 |
| | MTD | Theta degrees | M⇑ | N; m=1; M=3 | $1 \leq MTD \leq 180$ integer value | 1 | 1 |
| | MTY | minutia type | M⇑ | A; m=1; M=1 | MTY = E, B or X | 1 | 1 |
| | RPU | radius of position uncertainty | O⇑ | N; m=1; M=3 | $0 \leq RPU \leq 999$ | 0 | 1 |
| | MDU | minutiae direction of uncertainty | O⇑ | N; m=1; M=3 | $0 \leq MDU \leq 359$ | 0 | 1 |
| 9.332 | **MRA** | **MINUTIAE RIDGE COUNT ALGORITHM** | O | AN; m=5; M=6 | MRA = OCTANT or EFTS7 | 0 | 1 |
| 9.333 | **MRC** | **MINUTIAE RIDGE COUNTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 7992 |
| | MIA | minutia index A | M⇑ | N; m=1; M=4 | $1 \leq MIA \leq 9999$ integer value | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | MIB | minutia index B | M⇑ | N; m=1; M=4 | $1 \leq MIB \leq 9999$ integer value | 1 | 1 |
| | MIR | ridge count | M⇑ | N; m=1; M=2 | $1 \leq MIR \leq 99$ integer value | 1 | 1 |
| | MRN | reference number | O⇑ | N; m=1 M=1 | $1 \leq MRN \leq 8$ integer value | 0 | 1 |
| | MRS | residual | O⇑ | N; m=1; M=1 | MRS = 0 or 1 | 0 | 1 |
| 9.334 | **NMP** | **NO MINUTIA PRESENT** | O | A; m=1; M=1 | NMP = Y | 0 | 1 |
| 9.335 | **RCC** | **RIDGE COUNT CONFIDENCE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 7992 |
| | AXC | X coordinate Point A | M⇑ | N; m=1; M = 5 | $1 \leq AXC \leq EWI$ integer value | 1 | 1 |
| | AYC | Y coordinate Point A | M⇑ | N; m=1; M = 5 | $1 \leq AYC \leq EHI$ integer value | 1 | 1 |
| | BXC | X coordinate Point B | M⇑ | N; m=1; M = 5 | $1 \leq BXC \leq EWI$ integer value | 1 | 1 |
| | BYC | Y coordinate Point B | M⇑ | N; m=1; M = 5 | $1 \leq BYC \leq EHI$ integer value | 1 | 1 |
| | MRC | method of ridge counting | M⇑ | A; m=1; M=1 | MRC = A, T or M | 1 | 1 |
| | MCV | confidence value | M⇑ | N; m=1; M=2 | $0 \leq MCV \leq 99$ | 1 | 1 |
| 9.336-9.339 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.340 | **DOT** | **DOTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 999 |
| | DOX | dot X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq DOX \leq EWI$ | 1 | 1 |
| | DOY | dot Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq DOY \leq EHI$ | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | DOL | dot length | O⇑ | N; m=1; M=2 | $1 \leq DOL \leq 99$ integer value | 0 | 1 |
| 9.341 | **INR** | **INCIPIENT RIDGES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 999 |
| | X1C | X coordinate Point 1 | M⇑ | N; m=1; M = 5 | $1 \leq X1C \leq EWI$ integer value | 1 | 1 |
| | Y1C | Y coordinate Point 1 | M⇑ | N; m=1; M = 5 | $1 \leq X1C \leq EHI$ integer value | 1 | 1 |
| | X2C | X coordinate Point 2 | M⇑ | N; m=1; M = 5 | $1 \leq X2C \leq EWI$ | 1 | 1 |
| | Y2C | Y coordinate Point 2 | M⇑ | N; m=1; M = 5 | $1 \leq X2C \leq EHI$ | 1 | 1 |
| 9.342 | **CLD** | **CREASES AND LINEAR DISCONTINUITIES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 999 |
| | X1D | X coordinate Point 1 | M⇑ | N; m=1; M = 5 | $1 \leq X1D \leq EHI$ integer value | 1 | 1 |
| | Y1D | Y coordinate Point 1 | M⇑ | N; m=1; M = 5 | $1 \leq X1D \leq EWI$ integer value | 1 | 1 |
| | X2D | X coordinate Point 2 | M⇑ | N; m=1; M = 5 | $1 \leq X2D \leq EHI$ integer value | 1 | 1 |
| | Y2D | Y coordinate Point 2 | M⇑ | N; m=1; M = 5 | $1 \leq X2D \leq EWI$ integer value | 1 | 1 |
| | TPD | type | M⇑ | A; m=2; M=5 | See values in **Table 44** | 1 | 1 |
| 9.343 | **REF** | **RIDGE EDGE FEATURES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 999 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | CLX | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq CLX \leq EHI$ | 1 | 1 |
| | CLY | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq CLY \leq EWI$ | 1 | 1 |
| | CLT | type | M⇑ | A; m=1; M=1 | CLT = P, I or D | 1 | 1 |
| 9.344 | **NPP** | **NO PORES PRESENT** | O | A | NPP = Y | 0 | 1 |
| 9.345 | **POR** | **PORES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9999 |
| | POX | X coordinate | M⇑ | N; m=1; M = 5 | $1 \leq POX \leq EWI$ | 1 | 1 |
| | POY | Y coordinate | M⇑ | N; m=1; M = 5 | $1 \leq POY \leq EHI$ | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 9.346 | **NDT** | **NO DOTS PRESENT** | O | A; m=1; M=1 | NDT = Y | 0 | 1 |
| 9.347 | **NIR** | **NO INCIPIENT RIDGES PRESENT** | O | A; m=1; M=1 | NIR = Y | 0 | 1 |
| 9.348 | **NCR** | **NO CREASES PRESENT** | O | A; m=1; M=1 | NCR = Y | 0 | 1 |
| 9.349 | **NRE** | **NO RIDGE ENDGE FEATURES PRESENT** | O | A; m=1; M=1 | NRE = Y | 0 | 1 |
| 9.350 | **MFD** | **METHOD OF FEATURE DETECTION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 99 |
| | FIE | field | M⇑ | AN; m=5; M=999 | ALL or 9.300 < value < 9.373 separated by comma | 1 | 1 |
| | FME | method | M⇑ | A; m=3; M=4 | FME = AUTO, REV, EDIT or MAN | 1 | 1 |
| | FAV | algorithm vendor | C-FME | AN; m=1; M=40 | None | 0 | 1 |
| | FAL | algorithm | C-FME | AN; m=1; M=40 | None | 0 | 1 |
| | ESN | examiner surname | C-FME | AN; m=1; M=40 | None | 0 | 1 |
| | EGN | examiner given name | C-FME | AN; m=1; M=40 | None | 0 | 1 |
| | EAF | examiner affiliation | C-FME | AN; m=1; M=99 | None | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Max |
|---|---|---|---|---|---|---|---|
| | EMT | date and time | M⇑ | Dependent upon encoding[104] | $1900 \leq$ YYYY; $1 \leq MM \leq 12$; $1 \leq DD \leq 31$; $0 \leq hh \leq 23$; $0 \leq mm \leq 59$; $0 \leq ss \leq 59$; All above are integer values; EMT $\leq$ Today's date and time | 1 | 1 |
| | NTS | notes | O⇑ | ANS; m=1; M=99 | None | 0 | 1 |
| 9.351 | **COM** | **COMMENT** | O | AN; m=1; M=126 | None | 0 | 1 |
| 9.352 | **LPM** | **LATENT PROCESSING METHOD** | O | | | 0 | 1 |
| | LPC | latent processes code | M⇑ | A; m=3; M=3 | value from **Table 46** | 1 | 9 |
| 9.353 | **EAA** | **EXAMINER ANALYSIS ASSESSMENT** | O | | | 0 | 1 |
| | AAV | value | M⇑ | A; m=5; M=8 | AAV = VALUE, LIMITED, NOVALUE, or NONPRINT | 1 | 1 |
| | ALN | examiner last name | M⇑ | AN; m=1; M=40 | None | 1 | 1 |
| | AFN | examiner first name | M⇑ | AN; m=1; M=40 | None | 1 | 1 |
| | AAF | examiner affiliation | M⇑ | AN; m=1; M=99 | None | 1 | 1 |

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[104] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | AMT | date and time (GMT) | M⇑ | Dependent upon encoding[105] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $AMT \leq$ Today's date and time | 1 | 1 |
| | ACM | comment | O⇑ | ANS; m=1; M=200 | None | 0 | 1 |
| 9.354 | **EOF** | **EVIDENCE OF FRAUD** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4 |
| | FRA | fraud type | M⇑ | A; m=3; M=3 | FRA = EVA, SPO, FOR or FAB | 1 | 1 |
| | CFD | comment | O⇑ | ANS; m=1; M=200 | None | 0 | 1 |
| 9.355 | **LSB** | **LATENT SUBSTRATE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 3 |
| | CLS | code | M⇑ | N; m=1; M=2 | see values from **Table 46** | 1 | 1 |
| | CLC | comment | O⇑ | ANS; m=1; M=1000 | None | 0 | 1 |

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[105] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 9.356 | **LMT** | **LATENT MATRIX** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 3 |
| | TOM | code | M⇑ | N; m=1; M=2 | $0 \leq TOM \leq 10$ | 1 | 1 |
| | CLA | comment | O⇑ | ANS; m=1; M=1000 | None | 0 | 1 |
| 9.357 | **LQI** | **LOCAL QUALITY ISSUES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | LQT | type | M⇑ | A; m=4; M=10 | | 1 | 1 |
| | LQP | polygon | M⇑ | NS; m=11; M=1188 | None | 1 | 1 |
| | LQC | Comment | O⇑ | ANS; m=1; M=1000 | None | 0 | 1 |
| 9.358-9.359 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.360 | **AOC** | **AREA OF CORRESPONDENCE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | CIR | IDC reference | M⇑ | N; m=1; M=3 | $0 \leq CIR \leq 255$ | 1 | 1 |
| | AOP | Polygon (closed path) | M⇑ | NS; m=11; M=1188 | None | 1 | 1 |
| | CAC | comment | O⇑ | ANS; m=1; M=1000 | None | 0 | 1 |
| 9.361 | **CPF** | **CORRESPONDING POINTS OR FEATURES** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | COL | label | M⇑ | AN; m=1; M=3 | None | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | TOC | type of correspondence | M⇑ | A; m=1; M=2 | value from Table 53 | 1 | 1 |
| | CFN | corresponding field number | C-TOC | AN; m=3; M=3 | value from Table 52 | 0 | 1 |
| | FOC | corresponding field occurrence | C-TOC | N; m=1; M=3 | $1 \leq FOC \leq 999$ | 0 | 1 |
| | CXC | corresponding x coordinate | C-TOC | N; m=1; M=5 | $1 \leq CXC \leq EWI$ integer value | 0 | 1 |
| | CYC | corresponding y coordinate | C-TOC | N; m=1; M=5 | $1 \leq CYC \leq EHI$ integer value | 0 | 1 |
| | COC | comment | O⇑ | ANS; m=1; M=1000 | None | 0 | 1 |
| 9.362 | **ECD** | **EXAMINER COMPARISON DETERMINATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | EDC | IDC reference | M⇑ | N; m=2; M=4 | $0 \leq EDC \leq 255$ | 1 | 1 |
| | EDE | determination | M⇑ | A; m=4; M=16 | value from Table 54 | 1 | 1 |
| | WIP | work in progress | M⇑ | A; m=5; M=11 | WIP = PRELIMINARY or FINAL | 1 | 1 |
| | ELN | examiner last name | M⇑ | AN; m=1; M=40 | None | 1 | 1 |
| | EFN | examiner first name | M⇑ | AN; m=1; M=40 | None | 1 | 1 |
| | EAF | examiner affiliation | M⇑ | AN; m=1; M=99 | None | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | DTG | date and time (GMT) | M⇑ | Dependent upon encoding[106] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $DTG \leq$ Today's date and time | 1 | 1 |
| | CZZ | comment | O⇑ | ANS; m=1; M=200 | None | 0 | 1 |
| 9.363-9.371 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 9.372 | **SIM** | **SKELETONIZED IMAGE** | O | Base64; m=8; M= * | Base 64 allowed values | 0 | 1 |
| 9.373 | **RPS** | **RIDGE PATH SEGMENTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | NS; m=11; M=1188 | None | 1 | Unlimited |
| 9.374-9.399 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

### 8.9.1    Field 9.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.9.2    Field 9.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-9 record as found in the information item ID of **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

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[106] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

### 8.9.3 Field 9.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint was obtained. See **Clause 7.9** for details.

### 8.9.4 Field 9.004: Minutiae Format / FMT

This mandatory field is retained only for backward compatibility. It was a mandatory field in previous versions of the standard. This field shall always have a value "U", unless including legacy records 9.005 through 9.012 (described in *ANSI/NIST-ITL 1-2007* and *ANSI/NIST-ITL 2-2008*), when this field shall contain "S".

### 8.9.5 M1-378 Feature Set

This entire block of fields is optional. Descriptions of fields in the range 126-150 use the word 'mandatory' to indicate 'mandatory if this block of records is present'. "Optional" in this bloc of fields shall mean 'optional if this block of records is present'.

#### 8.9.5.1 Field 9.126: M1 CBEFF information / CBI

This field is mandatory if the M1-378 feature set is contained in the transaction. Otherwise, it shall not occur. It shall contain three information items when present.

- The first information item (**CBEFF Format Owner / CFO**) shall contain the value "27". This is the identification of the assigned by the International Biometric Industry Association (IBIA) to INCITS Technical Committee M1.

- The second information item (**CBEFF Format Type / CFT**) is assigned a value of "513" to indicate that this record contains **Field 9.137: M1 Finger minutiae data / FMD** without **Field 9.138: M1 Ridge count information / RCI** or **Field 9.139: M1 Core information / CIN** . A value of "514" indicates the presence all three fields[107].

- The third information item (**CBEFF Product Identifier / CPI**) identifies the "owner" of the encoding equipment. The vendor establishes this value. It may be obtained from the IBIA website (www.ibia.org) if it is posted.

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[107] Clarification of potential ambiguities in earlier versions of the standard.

### 8.9.5.2 Field 9.127: M1 Capture equipment identification / CEI.

This mandatory field shall contain two information items.

- The first (**Appendix F status / AFS**) shall contain "APPF" if the equipment used originally to acquire the image was certified to conform to Appendix F specifications[108]. If the equipment did not conform it will contain the value of "NONE".

- The second information item (**Capture Equipment ID / CEI**) shall contain a vendor-assigned product number / identifier (up to 30 characters) of the capture equipment. A value of "0" indicates that the capture equipment ID is unreported.

### 8.9.5.3 Field 9.128: M1 Horizontal line length /HLL

This is a mandatory field. See **Clause 7.19** for details.

### 8.9.5.4 Field 9.129: M1 Vertical line length / VLL

This is a mandatory field. See **Clause 7.19** for details.

### 8.9.5.5 Field 9.130: Scale units / SLC

This is a mandatory field. See **Clause 7.19** for details.

### 8.9.5.6 Field 9.131: M1 Horizontal pixel scale / HPS

This is a mandatory field. See **Clause 7.19** for details.

### 8.9.5.7 Field 9.132: M1 Vertical pixel scale / VPS

This is a mandatory field. See **Clause 7.19** for details.

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[108] See the list of certified products at http://fbibiospecs.org

### 8.9.5.8  Field 9.133: M1 Finger view / FVW

This mandatory field contains the view number of the finger associated with this record's data.  The view number begins with "0" and increments by one to "15".[109]

### 8.9.5.9  Field 9.134: M1 Friction ridge generalized position / FGP

This is a mandatory field. See **Clause 7.10** for details. Valid codes for this field are between 1 and 10 taken from **Table 4** to indicate the finger position.[110]

### 8.9.5.10 Field 9.135: M1 *Friction ridge quality data / FQD*

This mandatory field shall contain the quality of the overall finger minutiae data. There may be a subfield for each algorithm and predictive performance measure. Each subfield shall contain three information items as described in **Clause 7.18**.

### 8.9.5.11 Field 9.136: M1 *Number of minutiae / NOM*

This mandatory field shall contain a count of the number of minutiae recorded in this data block.

### 8.9.5.12 Field 9.137: M1 *Finger minutiae data / FMD*

The total number of subfields shall agree with the count found in **Field 9.136 (NOM)**. Each subfield has six information items.

- The first information item (**Minutia index number / MAN**), shall be initialized to "1" and incremented by "1" for each additional minutia in the fingerprint.

- The second information item (**'x' coordinate / MXC**) is expressed in pixel units.

- The third information item (**'y' coordinate / MYC)** is expressed in pixel units.

- The fourth information item (**Minutia angle / MAV)** is recorded in units of two degrees.  This value shall be nonnegative between 0 and 179.

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[109] Note that as in the 2007 version, this means one set of minutiae (from one image) per record.  In the 2008 version, the structure allowed this to repeat, and also allowed palm codes to be used.  That is not supported by the 2011 version.

[110] The 2007 version restricted this to fingerprint codes.  The 2008 version also allowed palm codes.  This version is consistent with the 2007 version – only allowing fingerprint codes.

- The fifth information **(Minutia type / MTY)** has a value of "0" to represent a minutiae of type "OTHER", a value of "1" for a ridge ending and a value of "2" for a ridge bifurcation.

- The sixth information item **(Quality of minutia / QOM)** shall range from 1 as a minimum to 100 as a maximum. A value of "0" indicates that no quality value is available. Note that this is an integer value.

***8.9.5.13 Field 9.138: M1 Ridge count information / RCI***

This field shall consist of a series of subfields.

The first subfield has three information items.
- The first information item (**Ridge count extraction method / REM**) shall have a value of 0, 1 or 2. A "0" indicates that no assumption shall be made about the method used to extract ridge counts, nor their order in the record. A "1" indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in four quadrants, and ridge counts for each center minutia are listed together. A "2" indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in eight octants, and ridge counts for each center minutia are listed together.

- The remaining two information items (**Filler 1 / FI1** and **Filler 2 / FI2**) of this first repeating subfield shall each contain "0".

Subsequent subfields have three information items each.

- The first information item (**Center minutia index / CMI**) is a positive integer.

- The second information item (**Neighboring minutia index / NMN**) is a positive integer. It shall not be equal to CMI.

- The third information (**Number of ridges crossed / NRC**) is a positive integer.

### 8.9.5.14 Field 9.139: M1 Core information / CIN

This field shall consist of one subfield for each core present in the original image. Each subfield consists of three information items.

- The first item (**'x' coordinate / XCC**) is an integer in pixel units.

- The second item (**'y' coordinate / YCC**) is an integer in pixel units.

- The third information item (**Angle of the core / AOC**) is recorded in units of 2 degrees. The value shall be between 0 and 179.
- 

### 8.9.5.15 Field 9.140: M1 Delta information / DIN

This field shall consist of one subfield for each delta present in the original image. Each repeating subfield consists of three information items.

- The first item (**'x' coordinate / XCD**) is an integer in pixel units.

- The second item (**'y' coordinate / YCD**) is an integer in pixel units.

- The third information item (**Angle of the delta / AOD**) is recorded in units of 2 degrees. The value shall be between 0 and 179.

#### 8.9.6    Extended Feature Set

This entire block of fields is optional. Descriptions of fields in the range 126-150 use the word 'mandatory' to indicate 'mandatory if this block of records is present" "Optional" in this block of fields shall mean 'optional if this block of records is present".

This data block defines the content, format, and units of measurement for the definition and/or exchange of friction ridge feature information that may be used in the identification of a subject based on friction ridge information. This information is intended for an individual examiner to define the content of a single impression or comparison of two impressions, as well as for interchange between criminal justice administrations or organizations that use friction ridge information for identification purposes.

The purpose of this specification is to define a quantifiable, repeatable, and clear method of characterizing the information content of a fingerprint or other friction ridge image.

*EFS Coordinate system*

The relative position of all Extended Friction Ridge Features shall be expressed as positive integers in units of 10 micrometers (0.01 mm or 0.00039 in), with the origin in the top left of the Region Of Interest (described below). In this coordinate system, values of X increase from left to right and values of Y increase from top to bottom. All positions shall be in the range (0,0)-(ROI.width-1, ROI.height-1).

Width and/or height dimensions for a single impression will always fall within an upper bound of 50 cm (19.7", or 50,000 units). Note that this is not counted in pixels.

*EFS Region of interest*

The Region of Interest is defined as a rectangle and/or a polygon that bounds the area of the original image containing a single friction ridge impression, and separates it from the background and any other friction ridge data present in the image. All other Extended Friction Ridge Features are in relation to the Region of Interest, not to the original image: all coordinates are relative to the top left corner of the ROI, and may not equal or exceed the width and height of the ROI. The ROI may be identical to the dimensions of the image.

*EFS Angles*

All angles are measured in positive integer degrees counterclockwise from the right, from 0 to 359 degrees, inclusive.

### 8.9.6.1 EFS Field 9.300: Region of Interest / ROI

See **Clause 8.9.6** for a general description of ROI. This mandatory field defines a rectangle (and an optional polygon) that bounds the region of the image that contains the fingerprint of interest and separates it from the background and any other fingerprints present in the image. This field contains six information items. Width and height are mandatory. The other items are optional.

· The first information item (**Width / EWI**) is the integer width of the region of interest in units of 10 micrometers (0.01mm)

· The second information item **(Height / EHI)** is the height of the region of interest in units of 10 micrometers (0.01mm).

· The third information item **(Horizontal offset / EHO)** is the horizontal distance in units of 10 micrometers from the left edge of the original image to the left edge of the region of interest. This information item defaults to a value of zero if absent.

- The fourth information item **(Vertical offset / EVO)** is the vertical distance in units of 10 micrometers from the top edge of the original image to the top edge of the region of interest. This information item defaults to a value of zero if absent.

- The fifth information item (**Polygon count of vertices / PCV)** shall contain the number of vertices in the polygon.

- The sixth information item (**ROI Polygon / ROP**) contains a polygon (closed path) that further defines the friction ridge area under consideration within the ROI. The format of polygons is described in **Clause 7.23**. If the polygon is defined, the ROI rectangle shall be the bounding box for the polygon. The vertices of the polygon are relative to the ROI.

### 8.9.6.2  EFS Field 9.301: Orientation / ORT

This optional field allows the orientation (deviation from upright) and its uncertainty to be specified. If this field is omitted, the direction shall default to 0 (upright) and uncertainty shall default to 15, indicating that the image is rotated 0±15°. If orientation cannot be determined, the uncertainty value shall be set to 180.

This field contains the following two information items:

- The first information item (**Direction / EOD**) contains the deviation of the region of interest from upright (fingertip up) in integer degrees. Positive angles are counterclockwise, negative angles are clockwise. A value of "0" indicates an upright direction. Valid values range from "-179" through "180".

- The second information item (**Uncertainty / EUC**) contains the uncertainty of the orientation direction, in non-negative integer degrees, so that the resulting orientation is Direction± Uncertainty°. Valid values range from "0" to "180": a value of "0" indicates a certain direction, while a value of "180" indicates an unknown orientation. If this information item is omitted, the uncertainty shall default to "15" (±15°).

### 8.9.6.3  EFS Field 9.302: Finger - Palm - Plantar position / FPP

This mandatory field shall contain one or more of the possible physical positions that correspond to the region of interest. For example, a region of interest that includes a finger's medial and proximal segment can note those as multiple data entries, with polygons to indicate the locations.

This field may contain multiple subfields to designate different positions (FGP) and/or segments (FSM); polygons are required in this case to delineate the locations of the positions. Polygons may overlap if appropriate. A subfield contains the following four information items:

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- The first information item (Friction ridge generalized position / FGP) contains the code number corresponding to the known or most probable position shall be taken and entered as a one- or two-character value.  The codes are listed in **Table 4**.  See **Clause 7.10**.

- The second information item (**Finger segment / FSM**) is optional and only applies to fingerprints in which all or part of the medial or proximal segments (lower joints) are present in the image, in which case the 3-character code from **Table 5** is used to indicate the finger segment position (DST, PRX, MED or UNK). See **Figure 1** for the segment positions. This information item defaults to DST if the Position Code indicates a fingerprint and the Finger Segment is not specified; in which case, the impression shall be regarded as including solely the distal segment with no substantive portions of the medial or proximal segments. This information item shall be omitted if the FGP Position Code indicates a palm or plantar.

- The third information item (**Off-center fingerprint / OCF**) is optional and only applies to fingerprints in which the impression does not contain the central area of the fingerprint (i.e. the core or a center point of reference), in which case the 1-character code from **Table 29** is used to indicate the off-center position of the fingerprint image. This information item shall be omitted if the Position Code indicates a palm or plantar.

- The fourth information item (**Segment Polygon / SGP**) is optional.  It is a closed path polygon that delineates the area that corresponds to the specified position / segment. See **Clause 7.23** for details.

**Table 29 Off-center fingerprint positions**

| Name | Code | Description |
| --- | --- | --- |
| Tip | T | The plain or rolled tip of the image |
| Right Side | R | The right side of the finger or thumb |
| Left Side | L | The left side of the finger or thumb |

### 8.9.6.4   EFS Field 9.307: Pattern Classification / PAT

This optional field contains fingerprint classification information for the image. This field shall only be used for fingerprints, and shall be omitted for other friction ridge impressions. The field consists of three information items grouped together in a subfield. There may be up to seven subfields, indicating all possible pattern classifications

·        The first information item (**General Class / GCF**) is the general set of pattern classifications (arch, whorl, left & right loop) used by most current automated systems. This is a two character value selected from **Table 30**.

·        The second information item (**Subclass / SUB**) is the detailed sub-classification of arches and whorls that may optionally be provided by a human examiner or automated system. This information item shall only be included for arches or whorls, and only if the sub-classification can be determined precisely. This is a two character value selected from **Table 30**.

·        The third information item (**Whorl - Delta Relationship / WDR**) may optionally be used by a human examiner or automated system to provide the relationship between the deltas in a whorl. This information item shall only be included for whorls if the subclass is known, and only if the whorl delta relationship can be determined precisely. This information item shall be set to

*        I (Inner),
*        O (Outer), or
*        M (Meeting).

**Table 30 Pattern classification codes**

| | Pattern Classification | General Class | Subclass | Whorl - Delta Relationship |
|---|---|---|---|---|
| Arches | Arch, type not designated | AU | | |
| | - Plain Arch | | PA | |
| | - Tented Arch | | TA | |
| Whorls | Whorl, type not designated | WU | | |
| | - Plain Whorl | | PW | I, O, or M |
| | - Central Pocket Loop | | CP | I, O, or M |
| | - Double Loop | | DL | I, O, or M |
| | - Accidental Whorl | | AW | I, O, or M |
| Loops | Right Slant Loop | RS | | |
| | Left Slant Loop | LS | | |
| Unable to print | Amputation | XX | | |
| | Temporarily unable to print (e.g., bandaged) | UP | | |
| Unable to classify | Unable to Classify | UC | | |
| | - Complete Scar | SR | | |
| | -Dissociated Ridges/Dysplasia | DR | | |

### 8.9.6.5 EFS Field 9.308: Ridge Quality/Confidence Map / RQM

Local friction ridge quality (as defined in the Ridge Quality Map) is an assessment of confidence in small local areas within an image. The local quality map is used to define the confidence in all other features, and therefore is key information. In addition, when the quality map indicates a high-quality region in which features are not marked, that information can be used as "negative features" or definitive absence of features, which can be used for exclusion.

For every cell in a grid superimposed on the Region of Interest, this optional field notes the local ridge quality of the friction ridge detail within that cell. Local ridge quality defines clarity in terms of the ability to discern detail in a given location. The quality of each cell will be represented with a local quality value 0 through 5 representing the quality of ridge detail in that cell, as specified in **Table 31**.

**Table 31 Local ridge quality codes**

| Local Quality Code | Name | Shorthand description | | Display color |
|---|---|---|---|---|
| 5 | Definitive pores | Pores and ridge edges are obvious and unambiguous | | Aqua [RGB=(0,240,240)] |
| 4 | Definitive ridge edges, debatable pores | Ridge edges, minutiae, and ridge flow are obvious and unambiguous; pores are either debatable or not present | | Blue [RGB=(0,0,255)] |
| 3 | Definitive minutiae, debatable ridge edges | Minutiae, and ridge flow are obvious and unambiguous; ridge edges are debatable | | Green [RGB=(0,255,0)] |
| 2 | Definitive ridge flow, debatable minutiae | Continuity of ridge flow is certain; minutiae are debatable | | Yellow [RGB=(255,255,0)] |
| 1 | Debatable ridge flow | Continuity of ridge flow is uncertain | | Red [RGB=(255,0,0)] |
| 0 | Background | No ridge information | | Black or no color [RGB=(0,0,0)] |

The field is comprised of a repeating set of values. The number of entries corresponds to the number of cells in a column of the image. Each row value is encoded as shown in **Table 32.** See **EFS Field 9.309: Ridge Quality Map Format / RQF** for the definition of the grid size and data representation.

### 8.9.6.6   EFS Field 9.309: Ridge Quality Map Format / RQF

This field defines the grid size or data representation format used in **EFS Field 9.308: Ridge Quality/Confidence Map / RQM**. Its use is conditional on the presence of that field. This field consists of two information items:

·        The first information item (**Grid size / GSZ**) shall be used to define grid sizes (both the horizontal and vertical dimensions of a single cell in the grid): valid settings range from "1" (0.01mm) through "41" (0.41mm). The recommended grid size is 0.20mm (0.008") – note this is 4 pixels at 500ppi, or 8 pixels at 1000ppi

·        The second information item (**Data format / RDF**) defines the format used in **Field 9.308**, using the codes defined in **Table 32.**  For all formats:

  o   The first cell starts at the top left corner of the Region of Interest, with cells in order left to right.

  o   All of the quality values for each row are stored in one repeating subfield.

  o   The data entries are ordered from top to bottom.

  o   If the width and/or height of the Region of Interest are not evenly divisible by the Grid Size, partial cells shall be included at the right and/or bottom of the ridge flow map.

The number of data entries in the field is the same as the number of cells in one column: the Region of Interest's height divided by the Grid Size, rounded up to the next integer.

**Table 32 Ridge quality map data representation format options**

| Code | Type | Description |
|------|------|-------------|
| UNC | Uncompressed (concatenated decimal) | The values for each grid cell in the Ridge Quality Map field are single-character integer values as defined in **Table 31**, with one character per cell. All quality values for one row are concatenated left to right, with one repeating subfield of **EFS Field 9.308: Ridge Quality/Confidence Map / RQM** for each row.<br><br>The number of characters in one repeating subfield of **Field 9.308** is the same as the number of cells in one row: the Region of Interest's width divided by the Grid Size, rounded up to the nearest integer. |
| RLE | Run-Length Encoded | The unencoded values for each entry are identical to those used in UNC format. The numeric values for each grid cell (0-5) are then replaced with alphabetic equivalents (A-F), and then any sequential runs of the same character are prefixed by the decimal count of repeated characters. Individual characters are not preceded by a count.<br><br>For example:<br>00000000000000000000000000000000000000000000000000 (50 characters)<br><br>Is saved as "50A"<br><br>00000000000011223345555554444422210000000000000000 (50 characters)<br><br>Is saved as "12A2B2C2DE7F5E2CB16A" (20 character |

### 8.9.6.7  EFS Field 9.310: Ridge Flow Map / RFM

This field contains the direction of friction ridges at sampling points throughout the region of interest. The sampling frequency is optionally defined in **EFS Field 9.311: Ridge Flow Map Format / RFF**, and otherwise defaults to 0.41 mm in uncompressed format. The first sampling point in the image is the top left-most point in the region of interest. The same sampling frequency is used both horizontally and vertically. Values shall be included for all sampling points in the region of interest, even if the sampling

points are at the edge of the region of interest. For each sampling point, angles shall be reported in integer degrees, with 0 degrees to the right (horizontal), increasing counterclockwise to a maximum value of 179° (since 180°=0°). Undefined angles are recorded in **EFS Field 9.311: Ridge Flow Map Format / RFF**. Each entry corresponds to one row of the map in order from top to bottom.

### 8.9.6.8   EFS Field 9.311: Ridge Flow Map Format / RFF

This optional field permits setting the sampling frequency or data representation format used in the **EFS Field 9.310: Ridge Flow Map / RFM** to values other than the defaults. Its use is conditional on the presence of **Field 9.310**. This field consists of two information items:

> · The first information item (**Sampling Frequency / SFQ**) is set by default to 0.41mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01mm) through "41" (0.41mm).

> · The second information item (**Data format / RDF**) defines the format used in the Ridge Flow Map field, as defined in Table 33. The default is the uncompressed ("UNC") format.

**Table 33 Ridge flow map data representation format options**

| Code | Type | Description |
|------|------|-------------|
| UNC | Uncompressed (concatenated hexadecimal) | Each ridge flow value is a 2-character hexadecimal value. The angles are stored in 2-character hexadecimal representation with leading zeros, so valid values range from "00" (0dec) to "B3" (179dec). Undefined angles: If the direction cannot be determined at a given location, the location at that point shall be marked as "XX". All of the ridge flow values for a given row shall be concatenated in order left to right and saved as a separate instance / repeating subfield of **EFS Field 9.310: Ridge Flow Map / RFM**.<br><br>The number of characters in one repeating subfield of **Field 9.310** is twice the number of cells in one row. |
| B64 | Base 64 | Each ridge flow value is a 1-character base-64 value. The angles are divided by three to enable storing in a single base-64 character, which has the effect of quantizing to three degrees. Undefined angles: If the direction cannot be determined at a given location, the location at that point shall be marked as "*" (asterisk). All of the ridge flow values for a given row shall be concatenated in order left to right and saved as a separate instance / repeating subfield of **Field 9.310**.<br><br>The number of characters in one instance of **EFS Field 9.310: Ridge Flow Map / RFM** is the number of cells in one row. |

### 8.9.6.9   EFS Field 9.312: Ridge Wavelength Map / RWM

This optional field contains the peak-to-peak distance between ridges at various sampling points throughout the region of interest. The sampling frequency is optionally defined in **EFS Field 9.313: Ridge Wavelength Map Format / RWF**, and otherwise defaults to 0.41 mm in uncompressed format. The first sampling point in the image is the top left-most point. The same sampling frequency is used both horizontally and vertically. Values shall be included for all sampling points in the image, even if the sampling points are at the edge of the image.

For each sampling point in the Region of Interest, distances between ridge peaks, measured perpendicular to ridge flow, shall be reported in 2-character decimal format using units of 10 micrometers (0.01mm). Unknown values shall be set to "XX". The 2-character decimal wavelength values for each sampling point are concatenated left to right for all sampling points in a row. Each entry corresponds to one row of the map, in order from top to bottom. The number of characters in one entry is twice the number of sampling points in one row.

### 8.9.6.10 EFS Field 9.313: Ridge Wavelength Map Format / RWF

This field permits setting the sampling frequency or data representation format used in **EFS Field 9.312: Ridge Wavelength Map / RWM** to values other than the defaults, and is conditional on the presence of **Field 9.312.** It consists of two information items:

· The first information item (**Sampling frequency / FWS**) is set by default to 0.41mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01mm) through "41" (0.41mm).

· The second information item (**Data format / FDF**) is optional. It defines the format used in **Field 9.312**. The default (and currently the only setting) is the uncompressed ("UNC") format.

### 8.9.6.11 EFS Field 9.314: Tonal Reversal / TRV

Ridges in friction ridge images are generally represented as dark areas, with valleys as light areas. This field indicates whether the entire image is reversed tonally (black-for-white). If all or part of the image is reversed tonally, this 1-character optional field is set to the appropriate value from the "Code" column of **Table 34**. Otherwise this field is omitted. If definable portions of the image are negative, **EFS Field 9.357: Local Quality Issues / LQI** may be used to define the specific tonally reversed areas. When this field is set, the image in the Type-13 record shall be left as it was received (tonally reversed).

**Table 34 Tonal reversal codes**

| Code | Description |
|------|-------------|
| N | Negative – ridges are light and valleys are dark throughout the image. |
| P | Partial – ridges are light and valleys are dark only in portions of the image. |

*8.9.6.12 EFS Field 9.315: Possible Lateral Reversal / PLR*

This field indicates if the original image is or may be laterally reversed (i.e., flipped left-right). In many cases, an examiner cannot tell the correct lateral direction of the image, such as latents on tape that has been closed on itself, or latents that may have been transferred to the substrate/surface. If the image is or may be laterally reversed, this 1-character optional field is set to the appropriate value from Table 35 otherwise, this field is to be omitted. When this field is set to L (Image is known to be laterally reversed), the image in the Type-13 record shall be left as it was originally received (i.e., laterally reversed).

**Table 35 Lateral reversal codes**

| Code | Description |
|------|-------------|
| L | Image is known to be laterally reversed. |
| U | Image may be laterally reversed |

*8.9.6.13 EFS Field 9.316: Friction Ridge Quality Metric / FQM*

This optional field is used to specify one or more different metrics of friction ridge quality for the friction ridge impression corresponding to this record, as delimited by the region of interest. Each subfield contains three information items, described in **Clause 7.18**.

This optional field is only used in the unusual circumstance that the friction ridge impression is believed to have changed size or scale from potential comparisons. This provides for handling of images from deceased subjects with desiccated skin, or with swollen skin due to water exposure. This also provides for handling of overall growth of subjects between capture, such as in comparing an adult's fingerprints with those taken as a child. In these cases the size of ridges and distances between ridges change to a greater extent than would ordinarily be assumed in comparisons; this field acts as a flag to indicate that greater than ordinary dimensional variation should be expected in performing subsequent comparisons.

This field is to be omitted unless there is reason to believe that growth or shrinkage may have occurred. This field consists of two information items:

· The first information item (**Type / TGS**) is selected from the "Code" column **Table 36.** It is one character.

· The second information item (**Comment / COM**) contains optional text describing the rationale for believing that growth or shrinkage may have occurred.

**Table 36 Growth or shrinkage codes**

| Code | Description |
|---|---|
| G | Growth: impression is believed to be dimensionally larger than exemplars or other prints from the same subject. |
| S | Shrinkage: impression is believed to be dimensionally smaller than exemplars or other prints from the same subject. |
| B | Both: impression may be dimensionally larger or smaller than exemplars or other prints from the same subject. |

A core is located at the focus of the innermost recurving ridge line of a ridge pattern: if the ridge is viewed as a section of a circle, the core is the center of that circle; if the ridge is viewed as an ellipse or parabola, the core is the focal point of that curve. The direction of the core is away from the center of the curve. The core or cores of a fingerprint are defined for all pattern classifications other than plain arches, as shown in **Table 37.** Cores may be marked on tented arches if an innermost recurving ridge is present above the delta, so that each side of the recurving ridge extends to either side of the delta. Plain or central pocket loop whorls will only have one core if the innermost recurving ridge is circular, or two cores if elliptical. A circular whorl only has one core and does not have a defined direction. Accidentals may have any number of cores.

For palmprints or other non-fingerprint friction ridge images, any number of core-like patterns may be defined using this field if such structures are present. Each core is defined in a separate subfield.

**Table 37 Number of cores and deltas by pattern class**

| Pattern Classification | | Cores | Deltas |
|---|---|---|---|
| Arches | - Plain Arch | 0 | 0 |
| | - Tented Arch | 0 or 1 | 0 or 1 |
| Whorls | - Plain Whorl | 1 or 2 | 2 |
| | - Central Pocket Loop | 1 or 2 | 2 |
| | - Double Loop | 2 | 2 |
| | - Accidental Whorl | N | N |
| Loops | | 1 | 1 |

Each subfield consists of the following information items:

·    The first information item (**'x' coordinate / CXC**) shall be expressed in integer units of 10 micrometers (0.01mm).

·    The second information item (**'y' coordinate / CYC**) shall be expressed in integer units of 10 micrometers (0.01mm)

· The third information item (**Direction / CDI**) is optional. This shall be set to the average tangent direction of the two closest ridges as measured 1.63mm (0.064 inches) from the focal point. This is approximately the same as the direction of the directrix of the best fitting parabola.  The direction shall be omitted (left empty) for circular whorls, or if the direction is unknown.

· The fourth information item (**Radius of position uncertainty / RPU**) defines the radius of a circle centered at the location (X,Y) of the core; the circle is sized to include the area of other possible locations of the core, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the image.

· The fifth information item (**Direction uncertainty / DUY**) is optional. It contains the uncertainty of the direction of the core, in non-negative integer degrees. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

### 8.9.6.16 EFS Field 9.321 Deltas / DEL

For fingerprints, one or more deltas are defined for all pattern classifications other than plain arches, as shown in **Table 38**.  For palmprints or other non-fingerprint friction ridge images, any number of delta-like patterns may be defined using this field if such structures are present. Each delta is defined in a separate subfield. Each subfield consists of the following information items:

· The first information item (**'x' coordinate / DXC**) is expressed in units of 10 micrometers (0.01mm) and is mandatory.

· The second information item (**'y' coordinate / DYC**) is expressed in units of 10 micrometers (0.01mm) and is mandatory.

· The third information item (**Direction up / DUP**) is optional and is expressed in degrees counterclockwise from the right[111].

· The fourth information item (**Direction left / DLF**) is optional and is expressed in degrees counterclockwise from the right[111].

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[111]. The three angles shall be reported in order by increasing angle, which for fingerprint deltas with known orientation will result in the order up, left, then right. These three information items may be omitted (left empty).

· The fifth information item (**Direction right / DRT**) is optional and is expressed in degrees counterclockwise from the right[111].

· The sixth information item (**Type / DTP**) is optional and contains the type of delta, as defined in **Table 38**.

· The seventh information item (**Radius of position uncertainty / RPU**) is optional. It defines the radius of a circle centered at the location (X,Y) of the delta; the circle is sized to include the area of other possible locations of the delta, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the image.

· The eighth information item (**Direction uncertainty up / DUU**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

· The ninth information item (**Direction uncertainty left / DUL**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

· The tenth information item (**Direction uncertainty right / DUR**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

**Table 38 EFS delta codes**

| Code | Applies to | Name | Description |
|------|-----------|------|-------------|
| L | Fingerprint | Left fingerprint delta | The delta to the left of the image for whorls or right loops. For accidentals with more than two deltas, this indicates the leftmost delta. |
| R | Fingerprint | Right fingerprint delta | The delta to the right of the image for whorls or left loops. For accidentals with more than two deltas, this indicates the rightmost delta. |
| I00 I02.. ..I10 | Palm | Interdigital delta (with finger number) | The deltas at the base of the fingers in the interdigital areas. The finger number shall be noted if known, else set to "00". Note that thumbs do not have interdigital deltas. |
| C | Palm | Carpal delta | The delta at the base of the palm where the thenar and hypothenar meet. |
| <empty> | Fingerprint, Palm, or Foot | Other delta | Any other delta or delta-like structure in a friction ridge impression. |

**8.9.6.17 EFS Field 9.322: Core Delta ridge counts / CDR**

This field contains the count of intervening ridges between each core and delta. Each ridge count has a minimum and maximum value, so that a range may be noted. If the exact value is known, then that value should be put in the minimum and maximum fields. If only a minimum is known, such as when a delta is not visible, the maximum value shall be omitted. Ridge counts may be any non-negative integer. When this field is used for fingerprints, ridge counts shall be provided between each core and each delta, unless there are more than two cores or two deltas in an accidental whorl, in which case only the leftmost and rightmost of the cores and deltas need be used for ridge counts. Each subfield represents a distinct core-delta ridge count. Each subfield consists of four information items:

- The first information item **(Core index / CIX)** is the index of the core corresponding to this count ("1" if only one core is defined). If the relevant core is not defined, this shall be set to "U" to indicate an upper core or "L" to indicate a lower core (whorls only), permitting minimum ridge counts when cores are not in the region of interest.

- The second information item **(Delta index / DIX)** is the index of the delta corresponding to this count ("1" if only one delta is defined). If the relevant delta is not defined, this shall be set to "L" to indicate a left delta or "R" to indicate a right delta, permitting minimum ridge counts when deltas are not in the region of interest.

- The third information item **(Minimum ridge count / MRC)** contains the precise ridge count, if it is known; otherwise, it contains the minimum of the range of ridge count values.

- The fourth information item **(Maximum ridge count / XRC)** contains the precise ridge count, if it is known; otherwise, it shall be omitted (left empty).

### 8.9.6.18 EFS Field 9.323: Center point of reference / CPR

This field contains the location of a center point of reference of a fingerprint, which may be used to define how centered a fingerprint is, as a feature, for registration or orientation, and for quality measurements. While the core may serve some of the same purposes, a center point of reference is defined for arches and provides a single center location for complex whorls, unlike cores.

The location of a center point of reference can be determined using different algorithms, as stored in the Method information item, in which case different center points of reference may be stored in different data entries (repeating subfield). The center point of reference is defined for fingerprints or toe prints, not for other types of friction ridge images. This field consists of the following information items:

- The first information item **(Method / CPM)** is the method of determining the X, Y location, selected from the "Code" column of **Table 39**. It is a one character value.

- The second information item **('x' coordinate / PXC)** is in units of 10 micrometers (0.01mm)

- The third information item **('y' coordinate / PYC)** is in units of 10 micrometers (0.01mm)

- The fourth information item **(Radius of position uncertainty / CRU)** is optional. The radius of position uncertainty is 0 (default) if the location is known precisely; otherwise the position is marked at the best estimate of position, with a radius including the area of other possible locations, in integer units of 10 micrometers (0.01mm). The radius of uncertainty may overlap the edge of the image.

**Table 39 EFS Methods of determining center point of reference locations**

| Code | Name | Description |
|------|------|-------------|
| L | Lateral center only | The center location is defined laterally (across the finger) but is not meaningful in the other dimension (longitudinally, or along the finger), such as for defining the center line of arches, tips, and lower joints. Lateral center is only meaningful if the orientation (**Field 9.301**) is known; the point marked is the center with respect to the orientation angle. |
| 0 | Uppermost point of the ridge with greatest curvature | For a fingerprint with a known or estimated orientation, the center point is determined by finding the highest point of each ridge that is convex and pointing upward, and measuring the curvature/peak angle by following the ridge 1.63mm (0.064in) in both directions from that point. The point with the minimum angle (greatest curvature) is the center point of reference. |
| 1 | Overall fingerprint focal point | The overall fingerprint focal point is the point where the lines perpendicular to ridge flow converge. |

### 8.9.6.19 EFS Field 9.324: Distinctive Features / DIS

This field is used to define one or more areas containing unusually discriminating features that are not fully defined using other Extended Friction Ridge Features. The characteristics noted in this field are specific to the friction skin itself, as opposed to issues specific to the impression (such as smudging) that are noted in **EFS Field 9.357: Local Quality Issues / LQI**.

This field consists of three information items:

·      The first information item (Type / DIT) is selected from the "Code" column of **Table 40**.

·      The second information item (**Distinctive Features Polygon / DFP**) is optional.  It is a closed path polygon that outlines the area of the distinctive feature. See **Clause 7.23.**

·      The third information items (**Distinctive Features Comment / DFC**) shall contain optional text describing the feature.  It is a maximum of 1000 characters.

**Table 40 EFS Types of distinctive features**

| Code | Description |
|---|---|
| SCAR | Scar |
| WART | Wart or blister |
| MINGROUP | Unusual group or cluster of minutiae |
| CORE | Unusually distinctive core area |
| DELTA | Unusually distinctive delta area |
| MINUTIA | Unusually shaped minutia |
| CREASE | Unusually distinctive crease |
| CLEAR | Large clear field of ridges; large clear area with no minutiae |
| DYSPLASIA | Dissociated ridges / Dysplasia |
| OTHERFEAT | Other unusual features not characterized elsewhere; details should be noted in comments |

### 8.9.6.20 EFS Field 9.325: No cores present / NCR

This optional field is used to indicate whether the analysis process has determined that no cores could be discerned in the image. If the analysis process has determined that no cores could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.21 EFS Field 9.326: No deltas present / NDL

This optional field is used to indicate whether the analysis process has determined that no cores could be discerned in the image. If the analysis process has determined that no cores could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.22 EFS Field 9.327: No distinctive features present / NDF

This optional field is used to indicate whether the analysis process has determined that no distinctive characteristics could be discerned in the image. If the analysis process has determined that no cores could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.23 EFS Field 9.331: Minutiae / MIN

The type of minutiae shall be marked if clearly identifiable as a ridge ending or bifurcation; otherwise, it shall be marked as unknown type. The location for a bifurcation shall be at the "Y" of the ridge, with the direction running down the valley. The location for a ridge ending or unknown type shall be at the "Y" of the valley, with the direction running up the ridge. If the precise location for a ridge ending cannot be ascertained, a radius of uncertainty shall be marked to include the area of possible locations. If the type is unknown, the radius of uncertainty shall be indicated.

There are three confidence values used to define how precisely the minutia are defined: confidence in existence, direction, and location. Each of these optional information items contains a positive integer value from "1" to "100" indicating the percentage confidence in the existence of the minutia. This field consists of multiple subfields, each consisting of six information items:

· The first information item **('x' coordinate / MXC)** is expressed in units of 10 micrometers (0.01mm).

· The second information item **('y' coordinate / MYC)** is expressed in units of 10 micrometers (0.01mm).

- The third information item **(Theta / MTD)** is expressed in degrees.
- The fourth information item **(Type / MTY)** is selected from the "Code" column of **Table 41.**
- The fifth information item **(Radius of position uncertainty / MRU)** defines the radius of a circle centered at the location (X,Y) of the minutia
- The sixth information item **(Direction uncertainty / MDU)** contains an integer value from "0" (default) to "180" indicating the precision in the direction (theta) of the minutia, measured in degrees. The resulting direction is Theta±Uncertainty°.

**Table 41 EFS Codes for minutia types**

| Code | Description |
|------|-------------|
| E | Ridge ending |
| B | Ridge bifurcation |
| X | Either ridge ending or bifurcation, not clearly distinguishable |

**8.9.6.24 EFS Field 9.332: Minutiae Ridge Count Algorithm / MRA**

This optional field defines the algorithm used in determining how neighboring minutiae are selected for use in the ridge counts in the Minutiae Ridge Counts (MRC) field. The value for this field shall be selected from the "Code" column of **Table 42**.

**Table 42 EFS Codes for minutiae ridge count algorithms**

| Code | Description |
|------|-------------|
| OCTANT | The minutiae used for ridge counts are the nearest neighbors in eight octants, with the center of the 0th octant defined by the current minutia's theta, and the 1st through 7th octants proceeding counter clockwise. Ridge count values are set to number of intervening ridges. (Default) |
| EFTS7 | Identical to OCTANT algorithm, except that ridge count values are one more than the number of intervening ridges. This was the format used by the FBI in its EFTS Version 7.1 |

*8.9.6.25 EFS Field 9.333: Minutiae Ridge Counts / MRC*

This field contains the counts of intervening ridges between specified minutiae. **EFS Field 9.332: Minutiae Ridge Count Algorithm / MRA** governs how the minutiae are selected for ridge counts, and the details of how the ridges are counted. Each ridge count is represented in a separate subfield.  Each subfield consists of five information items:

·   The first information item (**Minutia Index A / MIA**) contains the index of the first minutia.

·   The second information item (**Minutia Index B / MIB**) contains the index of the second minutia.

·   The third information item (**Ridge count / MIR**) contains the number of intervening ridges between minutiae A and B. Unknown ridge counts shall be omitted (left empty). The **EFS Field 9.332: Minutiae Ridge Count Algorithm / MRA** governs other details or special cases (if any).

·   The fourth information item (**Reference number / MRN**) is optional and, if used, contains a reference number specific to the ridge count algorithm. For the OCTANT and EFTS7 ridge count algorithms, this information item specifies the octant.

·   The fifth information item (**Residual / MRS**) is optional and is specific to the OCTANT and EFTS7 ridge count algorithms, specifying the half of the octant in which the neighboring minutia lies. The residual is 0 if the neighboring minutia lies in the clockwise half of the octant, or 1 if the minutia lies in the counterclockwise half of the octant.

*8.9.6.26 EFS Field 9.334: No Minutiae Present / NMP*

This optional field is used to indicate whether the analysis process has determined that no minutiae could be discerned in the image. If the analysis process has determined that no minutiae could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

*8.9.6.27 EFS Field 9.335: Minutiae Ridge Count Confidence / RCC*

This optional field is used to indicate confidence in intervening ridge counts between any two points. Each ridge count confidence value is represented in a separate data entry (repeating subfield). While primarily used to indicate ridge count confidence between minutiae, this confidence measure may also apply to other features such as Core/Delta ridge counts. This field consists of six information items:

- The first information item (**AX / AXC**) contains the x coordinates for Point A, in units of 10 micrometers (0.01mm).

- The second information item (**AY / AYC**) contains the y coordinates for Point A, in units of 10 micrometers (0.01mm).

- The third information item (**BX / BXC**) contains the x coordinates for Point B, in units of 10 micrometers (0.01mm).

- The fourth information item (**BY / BYC**) contains the y coordinates for Point B, in units of 10 micrometers (0.01mm).

- The fifth information item (**Method of Ridge Counting / MRC**) states the method by which ridge counts were determined and/or validated selected from **Table 43.**

- The sixth information item (**Confidence value / MCV)** contains the integer confidence value for a ridge count from 0 to 99, with 0 indicating no confidence

**Table 43 EFS Codes for methods of ridge counting**

| Value | Definition | Description |
|-------|-----------|-------------|
| A | Auto | The ridge count was automatically performed without human review |
| T | Manual Tracing | The ridge count was automatically determined, based on a skeletonized image created by a human examiner. |
| M | Manual Ridge Count | The ridge count was determined or validated manually by a human examiner. |

*8.9.6.28 EFS Field 9.340: Dots / DOT*

A dot is a single or partial ridge unit that is shorter than local ridge width. Longer ridge units are considered standard ridges and should be marked as such, with two ridge endings. Potential dots that are substantially thinner than local ridge width should be marked as incipient ridges. A dot is marked by its center point. Elongated dots may optionally have their length marked along the longest dimension. This field consists of a repeating subfield (one for each dot) with the following three information items:

- The first information item (**Dot 'x' coordinate / DOX**) is the x coordinate of the center of the dot, expressed in units of 10 micrometers (0.01mm).

- The second information item (**Dot 'y' coordinate / DOY**) is the y coordinate of the center of the dot, expressed in units of 10 micrometers (0.01mm).

- The third information item (**Dot length / DOL**) is an optional information item containing the length of the dot along its longest dimension in integer units of 10 micrometers.

### 8.9.6.29 EFS Field 9.341: Incipient Ridges / INR

An incipient is a thin ridge, substantially thinner than local ridge width. An incipient is marked with the (X, Y) endpoints along its longest dimension. If the incipient is a series of clearly separate (thin) dots, they should be marked as separate incipient ridges. If an unbroken incipient curves, it should be marked as a series of adjoining line segments. This field consists of a subfield for each incipient ridge, each with four information items:

- The first information item (**X1 / X1C**) contains the 'x' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

- The second information item (**Y1 / Y1C**) contains the 'y' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

- The third information item (**X2 / X2C**) contains the 'x' coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

- The fourth information item (**Y2 / Y2C**) contains the 'y' coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

### 8.9.6.30 EFS Field 9.342: Creases and Linear Discontinuities / CLD

This optional field defines the permanent flexion creases (shown in Figure 4), as well as linear discontinuities (creases, cracks, cuts, and thin or non-permanent scars). If a continuous discontinuity curves, it should be marked as a series of adjoining line segments. If a crease is feathered or composed of a series of crisscross creases, each of the short creases shall be marked separately. Each crease or linear discontinuity is represented as a separate subfield consisting of five information items:

- The first information item (**DX1 / X1D**) shall contain the 'x' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

- The second information item (**DY1 / Y1D**) shall contain the 'y' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

- The third information item (**DX2 / X2D**) shall contain the 'x' coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

- The fourth information item (**DY2 / Y2D**) shall contain the 'y' coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

- The fifth information item (**Type / TPD**) shall be noted using the codes from **Table 44**[112]

### Table 44 EFS Codes for permanent flexion creases

| Code | Name | Location |
|---|---|---|
| DIP | Distal interphalangeal crease | Finger between medial and distal segments, or Thumb between proximal and distal segments |
| PIP | Proximal interphalangeal crease | Finger between proximal and medial segments |
| PDC00 - PDC10 | Proximal digital crease | Finger or Thumb at Palm. The 2-digit position code for the relevant finger, selected from Table 4 is appended to the string PDC (e.g. PDC01-PDC10) The fingerprint position code is 00 if the finger position cannot be determined. |
| RLC | Radial longitudinal crease (Also known as bottom crease) | Palm around base of thumb (thenar) |
| PTC | Proximal transverse crease (Also known as middle crease) | Diagonal across palm |
| DTC | Distal transverse crease (Also known as top crease) | Palm at base of interdigital area |
| WC | Wrist crease | Wrist |

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[112] For fingerprints, the only permanent flexion crease is the DIP (the distal inter-phalangeal crease separating the distal and medial segments of the finger, or between the proximal and distal segments of the thumb); all other permanent flexion creases relate to the palms or lower finger joints. For a feathered crease, multiple line segments may all share the same flexion crease label.
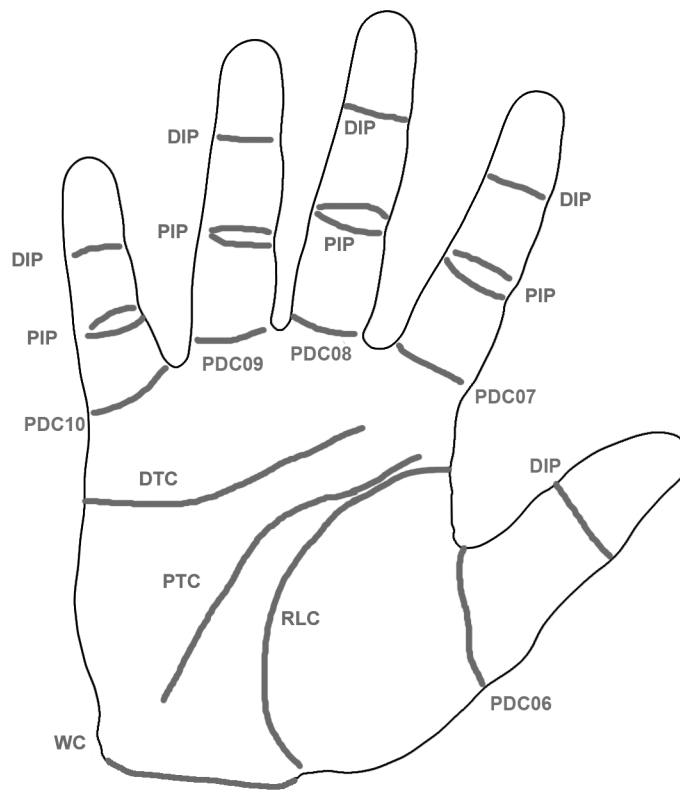
**Figure 4 EFS Locations of major flexion creases**

#### 8.9.6.31 EFS Field 9.343: Ridge Edge Features / REF

Ridge edge features include Protrusions (abrupt increases in ridge width), Indentations (abrupt decreases in ridge width), and Discontinuities (points where a ridge stops briefly). Each ridge edge feature is represented as a separate subfield consisting of three information items:

· The first information item **('x' coordinate / CLX)** contains the 'x' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

· The second information item **('y' coordinate / CLY)** contains the 'y' coordinate of one endpoint, in units of 10 micrometers (0.01mm).

· The third information item (**Type / CLT**) states the type of feature:

P (Protrusion), I (Indentation), or D (Discontinuity).

### 8.9.6.32 EFS Field 9.344: No pores present / NPP

This optional field is used to indicate whether the analysis process has determined that no pores (**EFS Field 9.345: Pores / POR**) could be discerned in the image. If the analysis process has determined that no dots could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.33 EFS Field 9.345: Pores / POR

Each pore is marked by its center point. Each pores is represented as a separate repeating subfield consisting of two information items:

· The first information item (**'x' coordinate / POX**) contains the 'x' coordinate of the center of the pore, in units of 10 micrometers (0.01mm).

· The second information item (**'y' coordinate / POY**) contains the 'y' coordinate of the center of the pore, in units of 10 micrometers (0.01mm).

### 8.9.6.34 EFS Field 9.346: No Dots Present / NDT

This optional field is used to indicate whether the analysis process has determined that no dots are present. If the analysis process has determined that no dots could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.35 EFS Field 9.347: No Incipient Ridges Present / NIR

This optional field is used to indicate whether the analysis process has determined that no incipient ridges could be discerned in the image. If the analysis process has determined that no incipient ridges could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.36 EFS Field 9.348: No Creases Present / NCR

This optional field is used to indicate whether the analysis process has determined that no creases could be discerned in the image. If the analysis process has determined that no creases could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.37 EFS Field 9.349: No Ridge Edge Features Present / NRE

This optional field is used to indicate whether the analysis process has determined that no ridge edge features could be discerned in the image. If the analysis process has determined that no ridge edge features could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted.

### 8.9.6.38 EFS Field 9.350: Method of Feature Detection / MFD

This optional field states the method(s) by which the Extended Friction Ridge features were detected and/or edited. Each time that fields are created or modified, the date and name of the automated algorithm or human examiner is noted in a new data entry (repeating subfield).[113] This field consists of nine information items, of which the first two are mandatory.

•        The first information item (**Field / FIE**) indicates which fields correspond to the method noted: it shall contain a single field (e.g. "9.331"), a comma-separated list of fields without spaces (e.g. "9.340,9.341,9.343"), or "ALL".

•        The second information item (**Method / FME**) shall state the method by which the fingerprint features were detected and encoded, using the values from the "Code" column of **Table 45**.

•        The third information item (**Algorithm vendor / FAV**) should identify the vendor of the encoding algorithm if the method is not "MAN".

•        The fourth information item (**Algorithm / FAL**) should identify the algorithm by name and version for methods other than "MAN".

•        The fifth information item (**Examiner surname / ESN**) should contain the surname (last name) of the fingerprint examiner, for methods other than "AUTO".

•        The sixth information item (**Examiner given name / EGN**) should contain the first name (given name, or first and middle names) of the fingerprint examiner for methods other than "AUTO."

•        The seventh information item (**Examiner affiliation / EAF**) should contain the employer or organizational affiliation of the examiner, for methods other than "AUTO".

•        The eighth information item (**Date and Time / EMT**) should contain the date and time that the determination was made, using Greenwich Mean Time (GMT).  See **Clause 7.15.2**.

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[113] When features are created or edited on multiple occasions, the new data entries should be added to this field without deleting the original data entries. For example, if minutiae are manually encoded by an examiner, then subsequently a second examiner modifies the minutiae, there would be two "MAN" entries for EFS Field 9.331: Minutiae / MIN.

- The ninth information item (**Notes / NTS**) is an optional item that may contain free text with additional information regarding the detection or modification of features.

**Table 45 EFS Codes for methods of feature detection**

| Code | Usage |
|---|---|
| AUTO | The fingerprint features were detected and encoded by an automated process without any possibility of human editing. The algorithm shall be noted in the appropriate information item. |
| REV | The fingerprint features were detected and encoded by an automated process, and manually reviewed without the need for manual editing. The algorithm and examiner's name shall be noted in the appropriate information items. |
| EDIT | The fingerprint features were detected and encoded by an automated process, but manually edited. The algorithm and examiner's name shall be noted in the appropriate information items. |
| MAN | The fingerprint features were manually detected and encoded. The examiner's name shall be noted in the appropriate information item. |

*8.9.6.39 EFS Field 9.351: Comments / COM*

This optional text field contains additional information not noted in other fields. This may include unformatted text information such as location, background information, or descriptive information. If comments need to be made about specific portions of the impression, use **EFS Field 9.324: Distinctive Features / DIS** or **EFS Field 9.332: Minutiae Ridge Count Algorithm / MRA**.

*8.9.6.40 EFS Field 9.352: Latent Processing Method / LPM*

This optional text field contains a three-letter code from **Table 46** indicating the technique(s) used to process the latent fingerprint. This field is only used for latent images. Unprocessed impressions (patent images visible to the naked eye) shall be

labeled VIS. Multiple methods should be marked by separate subfields. Methods should only be marked if they contributed substantively to the visualization of the image, and shall not be a list of all methods attempted.

**Table 46 EFS Codes for methods of latent processing**

| Code | Processing method | Code | Processing method |
|------|-------------------|------|-------------------|
| ADX | Ardrox | MBD | 7-p-methoxybenzylanimo-4-nitrobenz-2-oxa-1, 3-diazole |
| ALS | Alternate light source | MBP | Magnetic black powder |
| AMB | Amido black | MGP | Magnetic grey powder |
| BLE | Bleach (sodium hypochlorite) | MPD | Modified physical developer |
| BLP | Black powder | MRM | Maxillon flavine 10gff, Rhodamine 6g, and MBD |
| BPA | Black powder alternative (for tape) | NIN | Ninhydrin |
| CBB | Coomassie brilliant blue | OTH | Other |
| CDS | Crowle's double stain | PDV | Physical developer |
| COG | Colloidal gold | R6G | Rhodamine 6G |
| DAB | Diaminobenzidine | RAM | Cyanoacrylate fluorescent dye (Rhodamine 6G, Ardrox, MBD) |
| DFO | 1,8-diazafluoren-9-one | SAO | Safranin O |
| FLP | Fluorescent powder | SDB | Sudan black |
| GRP | Gray powder | SGF | Superglue fuming (cyanoacrylate) |
| GTV | Gentian violet | SSP | Stickyside powder |
| IOD | Iodine fuming | SVN | Silver nitrate |
| ISR | Iodine spray reagent | TEC | Theonyl Europiom Chelate |
| LAS | Laser | VIS | Visual (patent image, not processed by other means) |
| LCV | Leucocrystal violet | WHP | White powder |
| LQD | Liquid-drox | ZIC | Zinc chloride |

***8.9.6.41 EFS Field 9.353: Examiner Analysis Assessment / EAA***

This optional text field indicates an examiner's assessment of the value of the impression. This field consists of six information items, of which the first five are mandatory:

- · The first information item (**Value / AAV**) indicates the value of the impression, from **Table 47.**

- · The second information item (**Examiner last name / ALN**) shall contain the surname (last name) of the fingerprint examiner

- · The third information item (**Examiner first name / AFN**) shall contain the first name (given name, or first and middle names) of the fingerprint examiner

- · The fourth information item (**Examiner affiliation / AAF**) shall contain the employer or organizational affiliation of the examiner

- · The fifth information item (**Date and Time / AMT**) shall contain the date and time that the determination was made, using Greenwich Mean Time (GMT). See **Clause 7.15.2.**

- · The sixth information item is optional (**Comment / ACM**), and contains additional clarifying information for the examiner analysis assessment.

**Table 47 EFS Codes for value assessments**

| Code | Usage |
|---|---|
| VALUE | The impression is of value and is appropriate for further analysis and potential comparison. Sufficient details exist to render an individualization and/or exclusion decision. |
| LIMITED | The impression is of limited, marginal, value. It is not of value for individualization, but may be appropriate for exclusion. |
| NOVALUE | The impression is of no value, is not appropriate for further analysis, and has no use for potential comparison. |
| NONPRINT | The image is not a friction ridge impression. |

***8.9.6.42 EFS Field 9.354: Evidence of Fraud / EOF***

This text field indicates that there is basis for determination that the image may be fraudulent. This field consists of two information items:

- The first information item (**Type of fraud / FRA**) indicates the potential type of fraud attempted as determined from the impression, using the values in the "Code" column from **Table 48**.

- The second information item (**Comment / CFD**) contains text that provides clarifying information regarding the assessment of potential evidence of fraud.

**Table 48 EFS Codes for fraud type assessments**

| Code | Name | Usage |
|------|------|-------|
| EVA | Evidence of evasion | Evasion includes actions that prevent/lessen the likelihood of matching such as by degrading or obscuring physical characteristics or mutilating fingers. |
| SPO | Evidence of spoofing | Spoofing includes purposefully attempting to match a different person; techniques include modifying biological characteristics and using fabricated characteristics. |
| FOR | Evidence of forged evidence | Forged evidence is forensic evidence that was fraudulently placed on the surface from which it was collected. |
| FAB | Evidence of fabricated evidence | Fabricated evidence is forensic evidence that never existed on the surface from which it was supposedly collected. |

### 8.9.6.43 EFS Field 9.355: Latent Substrate / LSB

This field is used to define the substrate, or surface on which the friction ridge impression was deposited. If multiple substrates are present, they are represented by separate subfields consisting of the following information items:

- The first information item (**Code / CLS**) indicates the type of substrate, from the Code column of **Table 49**.

- The second information item **(Comment / CLC)** is optional and may contain text that provides clarifying information regarding the substrate.

**Table 49 EFS codes for types of latent substrates**

| Category | Code | Description |
|---|---|---|
| *Porous Substrate* | | |
| | 1A | Paper |
| | 1B | Cardboard |
| | 1C | Unfinished/raw wood |
| | 1D | Other/unknown porous substrate |
| *Nonporous Substrate* | | |
| | 2A | Plastic |
| | 2B | Glass |
| | 2C | Metal, painted |
| | 2D | Metal, unpainted |
| | 2E | Glossy painted surface |
| | 2F | Tape, adhesive side |
| | 2G | Tape, nonadhesive side |
| | 2H | Aluminum foil |
| | 2I | Other/unknown nonporous substrate |
| *Semi-porous Substrate* | | |
| | 3A | Rubber or latex |
| | 3B | Leather |
| | 3C | Photograph, emulsion side |
| | 3D | Photograph, paper side |
| | 3E | Glossy or semi-glossy paper or cardboard |
| | 3F | Satin or flat finish painted surface |
| | 3G | Other/unknown semi-porous substrate |
| *Other / Unknown Substrate* | | |
| | 4A | Other substrate (Specify) |
| | 4B | Unknown substrate |

*8.9.6.44 EFS Field 9.356: Latent Matrix / LMT*

This field is used to define the matrix, or substance deposited by the finger that forms the impression. Each latent matrix is represented by a separate data entry (repeating subfield). This field consists of two information items:

- The first information item is mandatory and indicates the **Type of matrix / TOM**, from the Code column of **Table 50**.

- The second information item (**Comment / CLA**) is optional and may contain text that provides clarifying information regarding the matrix.

**Table 50 EFS Codes for types of latent matrices**

| Code | Description |
|------|-------------|
| 1 | Natural perspiration and/or body oils (eccrine and/or sebaceous) |
| | *Visible contaminants:* |
| 2 | Blood |
| 3 | Paint |
| 4 | Ink |
| 5 | Oil or grease |
| 6 | Dirt or soil |
| 7 | Other visible contaminants |
| 8 | Impression in pliable material |
| 9 | Contaminant removal via touch |
| 10 | Other/unknown matrix |

*8.9.6.45 EFS Field 9.357: Local Quality Issues / LQI*

This optional field is used to define one or more areas containing quality or transfer issues that indicate that the anatomical friction ridge features may not have been accurately represented in the image. Each area with local quality issues is represented as a separate repeating subfield. The problems noted in this field apply to the specific impression under consideration; anatomical features of the friction skin itself (such as scars) are noted in (**EFS Field 9.324: Distinctive Features / DIS**). Each subfield consists of three information items:

- The first information item **(Type / LQT)** is the type of quality issue, selected from the "Code" column of **Table 51.**

- The second information item **(Polygon / LQP)** is a closed path outlining the area of the quality issue. See **Clause 7.23.**

- The third information item **(Comment / LQC)** is optional and may contain text describing the quality issue.

**Table 51 EFS Codes of quality issue types**

| Code | Description |
|---|---|
| ARTIFACT | Digital artifacts, such as occasionally caused by compression or livescan devices. |
| BACKGROUND | Interference with background makes following ridges difficult (e.g. check patterns) |
| COMPRESSED | Distorted area in which ridges are compressed together |
| DISTORT | Miscellaneous distortion (See also Compressed and Stretched) |
| NEGATIVE | Used if only a portion of the friction ridge image is tonally reversed (has ridges and valleys inverted so that ridges appear white and valleys appear black). Note that Field 9.314 Tonal Reversal (TRV) is used if the entire image is tonally reversed. |
| OVERDEV | Overdeveloped area: excessive processing medium such as ink, powder, etc. |
| OVERLAP | Area in which another friction ridge impression is superimposed over the impression of interest |
| SMEAR | Smeared or smudged area |
| STRETCHED | Distorted area in which ridges are stretched apart from each other |
| TAPE | Lifting tape artifacts (crease, bubble, etc.) |
| OTHER | Other quality issues not characterized elsewhere; details should be noted in Comments |

### 8.9.6.46 EFS Field 9.360: Area of Correspondence / AOC

This field is to be used only when two or more images contained in a single ANSI/NIST transaction are compared as candidates for individualization (potential mates). The area of correspondence is a polygon enclosing the region of usable ridge detail present in both images being compared. If the corresponding areas are discontinuous, more than one area of correspondence may be defined for a pair of images, each in a separate subfield.

One Type-9 record may have multiple AOCs defined that correspond to different images, as shown in **Figure 5**, each in a separate repeating subfield. **Figure 5** shows the interrelationships of the IDCs and AOCs for three different Type-9 records in a single transaction. Note that the AOC in a given Type-9 record contains an IDC reference for one or more other Type-9 record in a transaction. For example, a latent could have areas of correspondence with both the rolled and plain exemplars from one subject, or a latent could have areas of correspondence with candidate exemplars from two different subjects.

Each subfield consists of 3 information items:

- The first information item (**Corresponding IDC Reference / CIR**) indicates the IDC for the target image / Type-9 record for a given AOC. See **Clause 7.2.**

- The second information item (**Corresponding Polygon / AOP**) defines the outline of the corresponding area. It is a closed path. See **Clause 7.23** for a description of how to enter this information item.

- The third information item (**Corresponding Area Comment / CAC**) is optional and allows a free text comment or description related to the AOC.

IDCref=02

IDCref=01          IDCref=03

IDCref=02

IDC=01                    IDC=02                    IDC=03
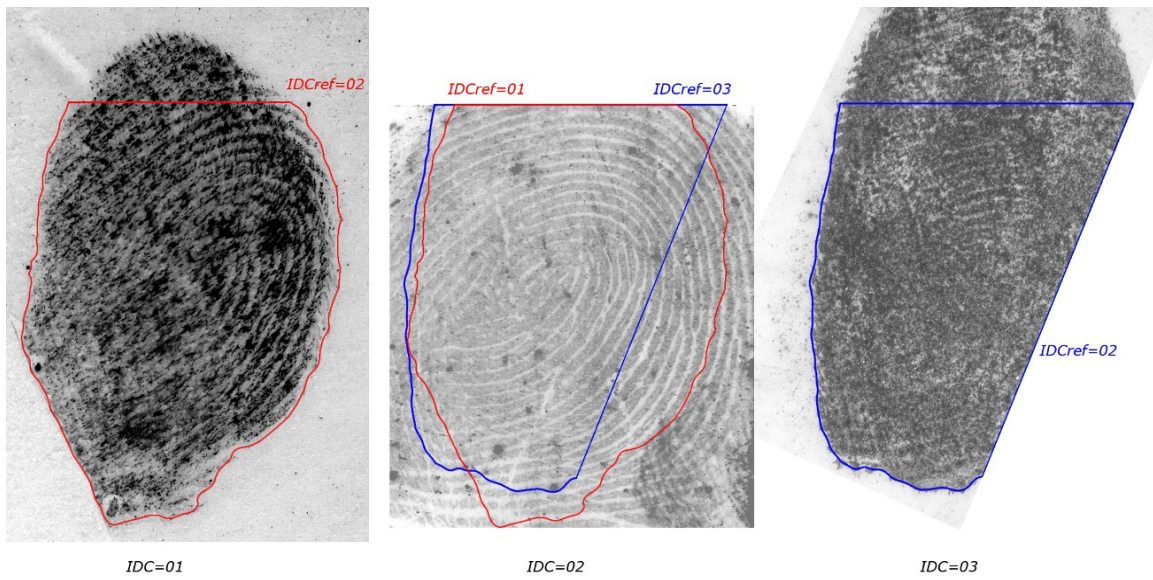
**Figure 5 EFS Examples of the use of IDC references in Areas of Correspondence for more than 2 images**

### 8.9.6.47 EFS Field 9.361: Corresponding Points or Features / CPF

This optional field is used to label points or features for comparison of the current feature set with other Type-9 feature sets in a transaction, as shown in **Figure 6**, which shows the interrelationships of the CPF labels for three different Type-9 records in a single transaction. This field is to be used only when two or more images contained in a single transaction are compared, either as candidates for individualization (potential mates), or for annotating reasons for exclusion. For each of the images being compared, specific points or features are marked in each of the Type-9 records, with correspondence indicated by the use of the same label, each in a separate data entry (repeating subfield). Labels within a single Type-9 record shall be unique. For example, if a transaction contains one latent and multiple candidate exemplars, a feature labeled "A" in the latent's Type-9 feature set corresponds with the feature labeled "A" (if present) in all of the exemplar Type-9 feature sets. Corresponding Points or Features may refer to arbitrary points, or may refer to predefined features (as noted in **Table 52**). The features include point features (such as minutiae, dots, or pores), but also may refer to areas (such as distinctive characteristics), lines (incipient ridges or creases), or paths (ridge path segments). Arbitrary points may be used to indicate characteristics that were not noted during analysis, or to indicate points in an exemplar that was not previously marked up.
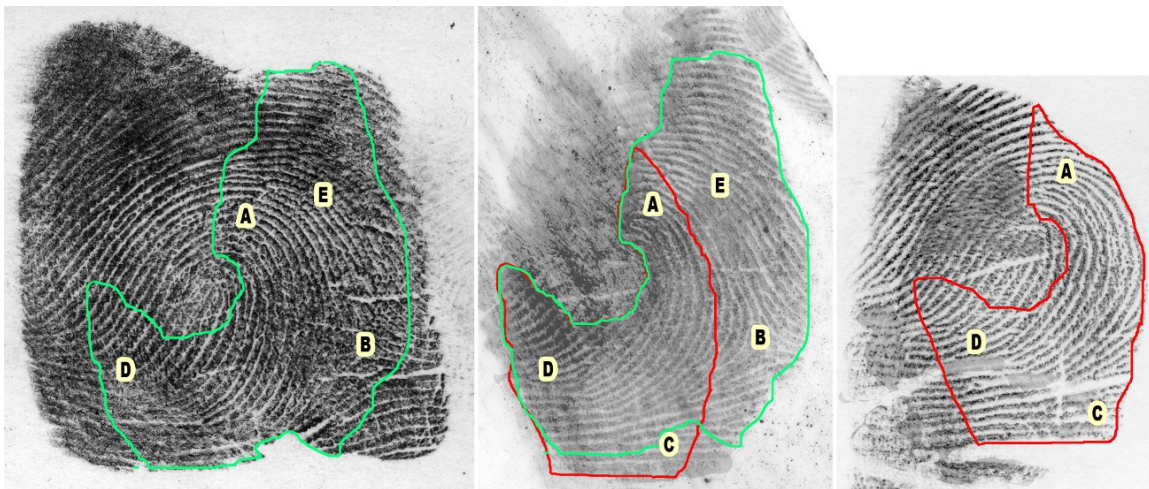


**Figure 6 EFS Examples of areas and points of correspondence in rolled exemplar, latent, and plain exemplar images**

Each feature corresponds to a separate subfield, which may be comprised of up to seven information items:

- The first information item (**Label / COL**) is a mandatory 1-3 character alphanumeric label is used to indicate correspondence between CPFs in different Type-9 records. The label names may be selected and assigned at the discretion of the system or the examiner. Labels within a single Type-9 record shall be unique. Note that the use of a given label in one type-9 record means that that point or feature corresponds with any or all other features with the same label in other Type-9 records in the transaction.

- The second information item (**Type of Correspondence / TOC**) is a mandatory 1- or 2-character information item (code) used to indicate the type of correspondence or non-correspondence, set to the appropriate "Code" value from **Table 53.**

- The third information item (**Corresponding field number / CFN**) is conditional, used only if TOC= F or DF. The Field Number information item indicates the type of field being compared, and shall correspond to the "Field number" column of **Table 52**. This is   the Type-9 field number of the compared field.

- The fourth information item (**Corresponding field occurrence / FOC**) is conditional, used only if TCR = F or DF. This information item indicates which repeating subfield of the specified field the label is applied to.  Note that this is a 1- based index, not a 0-based index.  Occurrences are numbered starting with 1.

- The fifth information item (**Corresponding x coordinate / CXC**) is conditional, used only if TCR = P or DP.  It is expressed in units of 10 micrometers (0.01mm).

- The sixth information item (**Corresponding x coordinate / CXC**) is conditional, used only if TCR = P or DP.  It is expressed in units of 10 micrometers (0.01mm).

- The seventh information item (**Comment / COC**) is optional and may contain a free text comment or description related to the CPF.

**Table 52 EFS Codes for field numbers used for corresponding features**

| Field number | Type |
|---|---|
| 320 | Cores |
| 321 | Deltas |
| 324 | Distinctive Characteristics |
| 331 | Minutiae |
| 340 | Dots |
| 341 | Incipient Ridges |
| 342 | Creases and Linear Discontinuities |
| 343 | Ridge Edge Features |
| 345 | Pores |
| 373 | Ridge Path Segments |

**Table 53 EFS Codes for types of corresponding points and features**

| Category | Code | Type | Description |
|---|---|---|---|
| Definite correspondence | F | Feature | The labeled feature definitely corresponds to the specific feature defined by the Field Number and Field Occurrence information items. (X and Y information items are unused) |
| | P | Point | The labeled feature definitely corresponds to the location with the coordinates defined in the X,Y information items. (Field Number and Field Occurrence information items are unused) |
| Possible or debatable correspondence | DF | Debatable Feature | The labeled feature may debatably correspond to the feature defined by the Field Number and Field Occurrence information items. (X and Y information items are unused) |
| | DP | Debatable Point | The labeled feature may debatably correspond to the location with the coordinates defined in the X,Y information items. (Field Number and Field Occurrence information items are unused) |
| Definite lack of correspondence | X | Does not exist | The labeled feature definitely does not exist in the impression, and the consistency of presentation of the potentially corresponding region is sufficient to make a definite determination. (X, Y, Field Number, and Field Occurrence information items are unused) |
| Inconclusive | R | Out of region | The labeled feature is not visible in the impression because it lies outside of the area of correspondence for this image: the feature may or may not be present, but the impression does not include the relevant area (X, Y, Field Number, and Field Occurrence information items are unused) |
| | U | Unclear area | The labeled feature is not visible in the impression because the potentially corresponding region is not sufficiently clear: the feature may or may not be present, but local quality issues prevent a definite determination. (X, Y, Field Number, and Field Occurrence information items are unused) |

***8.9.6.48 EFS Field 9.362: Examiner Comparison Determination / ECD***

This optional text field indicates an examiner's determination based on analysis and comparison of two specified friction ridge images. If multiple examiners' determinations are represented, each is contained separately in a repeating subfield. Comparison determinations against multiple impressions in the same transaction are specified in a separate subfield with distinct IDC references. Each subfield consists of at least seven information items. The eighth information item, **Comment / CZZ**, is optional:

- The first information item (**IDC Reference / EDC**) indicates the target image for a given determination, and is used in the same way as the IDC in **EFS Field 9.360: Area of Correspondence / AOC**. See **Clause 7.2.**

- The second information item (**Determination / EDE**) indicates a comparison conclusion, using the "Code" column from **Table 54**.

- The third information item (**Work in Progress / WIP**) is set to "PRELIMINARY" (default) or "FINAL". For a determination to be accepted for further processing, the status shall be set to "FINAL". The purpose of this is to allow saving work in progress.

- The fourth information item (**Examiner last name / ELN**) is the surname (last name) of the fingerprint examiner.

- The fifth information item (**Examiner first name / EFN**) is the given name (first name or first and middle names) of the fingerprint examiner.

- The sixth information item (**Examiner affiliation / EAF**) is the employer or organizational affiliation of the examiner.

- The seventh information item (**Date and Time / DTG**) is the date and time that the determination was made, in terms of Greenwich Mean Time (GMT) units. See **Clause 7.15.2.**

- The eighth information item (**Comment / CZZ**) is optional and may contain text that provides clarifying or qualifying information regarding the comparison determination.

**Table 54 EFS Codes for comparison determinations**

| Code | Description | Usage |
|------|-------------|-------|
| INDIV | Individualization | The two impressions originated from the same source. |
| INC_I | Inconclusive due to insufficient information | Individualization and exclusion are not possible because of insufficient corresponding or contradictory data. This category should be used if the specific other types of inconclusive determinations do not apply. |
| INC_C | Inconclusive, but with corresponding features noted | No conclusive determination can be made. Corresponding features are present, and no substantive contradictory features are present. The correspondence of features is supportive of the conclusion that the two impressions originated from the same source, but not to the extent sufficient for individualization.<br>This determination should be made if the examiner determines that the impressions are almost certainly from the same source, but cannot make an individualization determination. This is sometimes described as a qualified conclusion. |
| INC_D | Inconclusive, but with dissimilar features noted | No conclusive determination can be made. Non-corresponding features are present. The dissimilarity of features is supportive of the conclusion that the two impressions originated from different sources, but not to the extent sufficient for exclusion.<br>This determination should be made if the examiner determines that the impressions are almost certainly not from the same source, but cannot make an exclusion determination. This is sometimes described as a qualified exclusion. |
| INC_N | Inconclusive due to no overlapping area | Individualization and exclusion are not possible because no corresponding or potentially corresponding areas of friction ridge detail are present.<br>This determination should be made if there is sufficient information in the impressions to determine that there are no areas in the impressions to compare, such as when one print is of the left half of a finger and the other is of the right half. |
| EX_SRC | Exclusion of source | The two impressions originated from different sources of friction ridge skin (e.g. different fingers), but the subject cannot be excluded. |
| EX_SUB | Exclusion of subject | The two impressions originated from different subjects. |
| NONE | No determination | No determination has been made. (default) |

***8.9.6.49 EFS Field 9.372: Skeletonized Image / SIM***

This optional field contains a skeletonized image, also known as a ridge tracing, which reduces the friction ridge impression to an image with thinned representations of each ridge. The skeletonized image is a 2-tone image with a white background and a black single-pixel-wide thinned representation of each ridge. The same information may alternatively be represented using **EFS Field 9.373: Ridge Path Segments / RPS**.

The skeletonized image, also know as ridge tracing, is stored as a 1-bit grayscale PNG compressed image, bit-packed 6 bits per character using Base-64 representation. The entire PNG-formatted image is included as a single data entry / information item. Interlacing, alpha transparency, and color palettes shall not be used. The resolution of the skeletonized image shall be the same as the original image. Each black pixel may have 1,2, or 3 neighboring black pixels (1,2,3-connexity); other values (0, 4-8) are errors. The skeletonized image's dimensions shall be identical width and height of the ROI.

### 8.9.6.50 EFS Field 9.373: Ridge Path Segments / RPS

This optional field contains an alternate representation of the same skeletonized image data contained in **EFS Field 9.372: Skeletonized Image / SIM**. Each ridge path segment is saved as an open path (ordered set of vertices). See **Clause 7.23.** Multiple segments may be included in this field. Incipient ridges, dots, ridge discontinuities, and protrusions are not included in the ridge path representation. Each skeletonized ridge segment is stored as a separate subfield. Each endpoint of a ridge segment is either shared by three ridge segments (at a bifurcation) or is unique to a single ridge segment (at a ridge ending).

Each ridge path segment (if completely visible) is the portion of a ridge that connects two minutiae, so each ridge path segment starts and stops either where the ridge intersects another ridge path segment (a bifurcation) or ends (a ridge ending). In the infrequent case in which a ridge segment forms a complete loop back on itself without intersecting another ridge segment (such as near the core of some plain whorls or central pocket loops), the ridge path starts and stops at a single arbitrary point on the ridge. Ridge path segments may not be visible over their entire length due to image consistency-of-presentation problems or due to being truncated by the edge of the impression, and therefore one or both ends of a ridge segment may not end at points defined as minutiae.

### 8.9.7 Externally defined feature sets

This standard has reserved several blocks of fields for external definition. These blocks of fields may be used in conjunction with other blocks of fields[114].

### 8.9.7.1 FBI / IAFIS feature set

**Fields 9.013 through 9.030** are reserved for this block. For information on these fields, consult www.fbibiospecs.org

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[114] This was allowed in the 2007 version of the standard, but not the 2008 version. This version is consistent with the 2007 version, in allowing multiple blocks in a single record.

### 8.9.7.2 Cogent feature set

**Fields 9.031 through 9.055** are reserved for this block. For information on these fields, consult Cogent Systems or its successor organization.

### 8.9.7.3 Motorola feature set

**Fields 9.056 through 9.070** are reserved for this block. For information on these fields, consult Motorola or its successor organization.

### 8.9.7.4 Sagem Morpho featuresSet

**Fields 9.071 through 9.099** are reserved for this block. For information on these fields, consult Sagem Morpho or its successor organization.

### 8.9.7.5 NEC feature set

**Fields 9.100 through 9.125** are reserved for this block. For information on these fields, consult NEC or its successor organization.

### 8.9.7.6 IDENTIX feature set

**Fields 9.151 through 9.175** are reserved for this block. For information on these fields, consult L1 or its successor organization.

### 8.9.7.7 Other feature sets

**Fields 9.176 through 9.225** are reserved for this block. This block of fields is reserved for those vendors whose proprietary feature set was not available or not included in the *ANSI/NIST-ITL 1-2007* standard. Vendors who believe that the M1-378 feature set and the Extended Feature Set do not meet the requirements of their algorithms may use these proprietary feature set fields. These fields may also be used by those vendors with previously registered minutiae blocks for the purpose of identifying the use of different processing algorithms. Fields labeled mandatory in this clause are only mandatory if the block is used. Otherwise, the field shall be absent from the transaction.

#### 8.9.7.7.1 Field 9.176: Other feature set owner or developer / OOD

This mandatory field shall contain an unformatted text string identifying the editing station or the name of the owner or developer of the processing algorithm.

#### 8.9.7.7.2 Field 9.177: Other feature set processing algorithm / PAG

This mandatory field shall contain the identification of the name and version of the processing algorithm. This single information item shall be an unformatted text string.

8.9.7.7.3 Field 9.178: Other feature set system or device / SOD

This optional field shall contain an unformatted text string with the name of the system or device for which the data in this record is being generated as the first information item. The second information item is optional, to identify the version of the data generated.

8.9.7.7.4 Field 9.179: Other feature set descriptive text / DTX

This mandatory field shall contain the contact information for additional details regarding the feature data. This single information item shall be an unformatted text string identifying the name of the organization responsible for the information content.

8.9.7.7.5 Fields 9.180 through 9.225: Other feature set - defined fields

These fields shall be used to record specific vendor proprietary information regarding minutiae feature data. The vendor shall define the format and content of each field.

### 8.9.8    Latent workstation annotations

#### 8.9.8.1   Field 9.901: Universal latent workstation annotation information /  LAI

This optional field is used to store annotation, logging, or processing information associated with the FBI-developed Universal Latent Workstation (ULW) or compatible software. If present, this text field shall consist of one or more entries, each with up to 300 characters that describe a single processing step. Each entry shall begin with the date and time followed by a hyphen encoded as: "{M}M/{D}D/YYYY {h}h:mm:ss {AM|PM} - " *(*e.g. "3/27/2010 7:21:47 PM - "). The remainder of the entry shall contain an unformatted text string describing a process or procedure applied to the fingerprint, palmprint, or plantar print associated with this Type-9 record. Additional entries may be included, each describing a subsequent processing step.

#### 8.9.8.2   Field 9.902: Annotated Information / ANN

This optional field is used to store annotation, logging, or processing information associated with one or more processing algorithms or latent workstations (other than the FBI-developed ULW). See **Clause 7.5.**

## 8.10 Record Type-10: Facial, other body part and SMT image record

Type-10 records shall contain face, SMT, and / or other body part image data and related information pertaining to the specific image contained in this record.  It shall be used to exchange both grayscale and color image data in a compressed or uncompressed form.

**Table 55 Type-10 record layout[115]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.001 | | RECORD HEADER[116] | M | | | 1 | 1 |
| 10.002 | IDC | INFORMATION DESIGNATION CHARACTER | M | N; m=1; M= 3 | $0 \leq IDC \leq 255$[117] integer value | 1 | 1 |
| 10.003 | IMT | IMAGE TYPE | M | ANS; m=1; M=2 | value from Table 56[118] | 1 | 1 |

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[115] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[116] The Record Header content is encoding specific.  See the appropriate encoding annex for information on this field.

[117] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC.  However, it was never explicitly mentioned in earlier versions of the standard.

[118] Expanded to include other images besides face or SMT.  This expansion is new to this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 10.004 | ORG[119] | ORIGINATING AGENCY | M | | | 1 | 1 |
| | ORI | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | OAN | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 10.005 | PHD | PHOTO CAPTURE DATE | M | Dependent upon encoding[120] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $PHD \leq$ Today's date | 1 | 1 |
| 10.006 | HLL | HORIZONTAL LINE LENGTH | M | N; m=2; M=5 | $10 \leq HLL \leq 99999$ integer value[121] | 1 | 1 |
| 10.007 | VLL | VERTICAL LINE LENGTH | M | N; m=2; M=5 | $10 \leq VLL \leq 99999$ integer value239 | 1 | 1 |
| 10.008 | SLC | SCALE UNITS | M | N; m=1; M=1 | $0 \leq SLC \leq 2$ integer value | 1 | 1 |
| 10.009 | HPS | HORIZONTAL PIXEL SCALE | M | N; m=1; M=4 | integer value | 1 | 1 |
| 10.010 | VPS | VERTICAL PIXAL SCALE | M | N; m-1; M=4 | integer value | 1 | 1 |
| 10.011 | CGA | COMPRESSION ALGORITHM | M | A; m=3; M=5 | value from **Table 12** | 1 | 1 |

---

[119] Note the structure.  In the 2007 version, only the Identifier was included in the field.  In the 2008 version, the optional name was added.  For consistency, the name is optional in this version.

[120] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

[121] Clarification of potential ambiguities in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.012 | **CSP** | **COLOR SPACE** | M | A; m=3; M=4 | CSP = UNK, GRAY, RGB, SRGB, YCC or SYCC | 1 | 1 |
| 10.013 | **SAP** | **SUBJECT ACQUISITION PROFILE** | C-IMT | N; m=1; M=3 | See values in **Table 6** | 0 | 1 |
| 10.014 | **FIP** | **FACE IMAGE POSITION COORDINATES w/in FULL IMAGE** | O; C-IMT | | | 0 | 1 |
| | LHC | left horizontal coordinate value | M⇑ | N; m=1; M=5 | $1 \leq LHC \leq HLL$ integer value | 1 | 1 |
| | RHC | right horizontal coordinate value | M⇑ | N; m=1; M=5 | $1 \leq RHC \leq HLL$ integer value RHC > LHC | 1 | 1 |
| | THC | top horizontal coordinate value | M⇑ | N; m=1; M=5 | $1 \leq THC \leq VLL$ integer value | 1 | 1 |
| | BHC | bottom horizontal coordinate value | M⇑ | N; m=1; M=5 | $1 \leq BHC \leq VLL$ integer value BHC > THC | 1 | 1 |
| | BBC | bounding box code | O⇑ | A; m=1; M=1 | BBC = S, H, F, N or X | 0 | 1 |
| 10.016 | **SHPS** | **SCANNED HORIZONTAL PIXEL SCALE** | O | N; m=1; M=4 | positive integer value | 0 | 1 |
| 10.017 | **SVPS** | **SCANNED VERTICAL PIXEL SCALE** | O | N; m=1; M=4 | positive integer value | 0 | 1 |
| 10.018 | **DIS**[122] | **DISTORTION** | O | | | 0 | 1 |
| | IDK | distortion code | M⇑ | A; m=6; M=10 | IDK = Barrel or Pincushion | 1 | 1 |
| | IDM | distortion measurement code | M⇑ | A; m=1; M=1 | IDM = E or C | 1 | 1 |

[122] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | DSC | distortion severity code | M⇑ | A; m=4; M=8 | DSC = Mild, Moderate or Severe | 1 | 1 |
| 10.019 | **LAF239** | **LIGHTING ARTIFACTS** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | A; m=1; M=1 | value = F, H or R | 1 | 3 |
| 10.020 | **POS** | **SUBJECT POSE** | O; C-IMT | A; m=1; M=1 | POS = F, R, L, A or D | 0 | 1 |
| 10.021 | **POA** | **POSE OFFSET ANGLE** | C-POS; C-IMT | N; m=1; M=4 | $-180 \leq POA \leq 180$ integer value | 0 | 1 |
| 10.022 | **DEPRECATED** | **See ANSI/NIST-ITL 1-2007 for a description of this field** | | | | | |
| 10.023 | **PAS** | **PHOTO ACQUISITION SOURCE** | C-SAP; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 0 | 8 |
| | PAC | photo attribute code | M⇑ | A; m=6; M= 13 | value from **Table 59** | 1 | 1 |
| | VSD | vendor-specific description | C-PAC | ANS; m=1; M=64 | None | 0 | 1 |
| 10.024 | **SQS** | **SUBJECT QUALITY SCORES** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[123] |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ integer value or QVU = 254 or 255 | 1 | 1 |

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[123] This upper limit has been stated in this version to maintain consistency across all encodings and record types.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 10.025 | **SPA** | **SUBJECT POSE ANGLES** | C-POS | | | 0 | 1 |
| | YAW | yaw angle | M⇑ | N; m=1; M=4 | $-180 \leq YAW \leq 180$ integer value | 1 | 1 |
| | PIT | pitch angle | M⇑ | N; m=1; M=3 | $-90 \leq PIT \leq 90$ integer value | 1 | 1 |
| | ROL | roll angle | M⇑ | N; m=1; M=4 | $-180 \leq PIT \leq 180$ integer value | 1 | 1 |
| | YAWU | uncertainty in degrees for yaw | O⇑ | N; m=1, M=2 | $0 \leq YAWU \leq 90$ integer value | 0 | 1 |
| | PITU | uncertainty in degrees for pitch | O⇑ | N; m=01 M=2 | $0 \leq PITU \leq 90$ integer value | 0 | 1 |
| | ROLU | uncertainty in degrees for roll | O⇑ | N; m=1; M=2 | $0 \leq ROLU \leq 90$ integer value | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 10.026 | SXS | SUBJECT FACIAL DESCRIPTION | C-SAP; C-IMT | | | 0 | 1 |
| | | *Subfields: repeating values* | | | | 1 | 50[124] |
| | | attribute code | M⇑ | ANS= m=3[125]; M=20 | None | 1 | 1 |
| 10.027 | SEC | SUBJECT EYE COLOR | C-SAP; C-IMT | A; m=3; M=3 | value from **Table 20** | 0 | 1 |
| 10.028 | SHC | SUBJECT HAIR COLOR | C-SAP; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | A; m=3; M=3 | value from **Table 61** | 1 | 2 |

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[124] This is the limit from the 2007 version of the standard. The 2008 version was unlimited. This version adopts the 2007 value for all encodings.

[125] The minimum was 5 in the 2007 version of the standard, but there is a 3 character value in the table (HAT)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.029 | **FFP** | **2D FACIAL FEATURE POINTS** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 88[126] |
| | FPT | feature point type | M⇑ | N; m=1; M=1 | FPT = 1 or 2[127] | 1 | 1 |
| | FPC | feature point code | M⇑ | ANS; m=3; M=4 | Format: N.N, N.NN, NN.N, NN.NN, a, aa, aaa or aaaa; values from **Figure 9**, **Table 62** and **Table 63**[128] | 1 | 1 |
| | HCX | X coordinate | M⇑ | N; m=1; M=5 | 1 < HCX < HLL integer value | 1 | 1 |
| | HCY | Y coordinate | M⇑ | N; m=1; M=5 | $1 \leq HCY \leq VLL$ integer value | 1 | 1 |

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[126] This is the limit from the 2007 version of the standard. The 2008 version was unlimited. This version adopts the 2007 value for all encodings.

[127] In the 2007 and 2008 versions, this was restricted to a value of 1.

[128] Expanded possible formats (from previous versions of the standard) with the addition of new facial point codes.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=7; M=10 | Entries from **Table 11** | 0 | 1 |
| 10.031 | **TMC[129]** | **TIERED MARKUP COLLECTION** | O; C-FFP; C-FEC | N; m=1; M=3 | Integer value | 0 | 1 |
| 10.032 | **AFF[129]** | **3D FACIAL FEATURE POINTS** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 88 |
| | FPT | feature point type | M⇑ | N; m=1; M=1 | FPT = 1 or 2 | 1 | 1 |
| | FPC | feature point code | M⇑ | ANS; m=3; M=5 | Format: N.N, N.NN, NN.N, NN.NN, a, aa, aaa or aaaa; values from **Figure 9**, **Table 62** and **Table 63** | 1 | 1 |
| | HCX | X coordinate | M⇑ | N; m=1; M=5 | $1 \leq HCX \leq HLL$ integer value | 1 | 1 |
| | HCY | Y coordinate | M⇑ | N; m=1; M=5 | $1 \leq HCY \leq VLL$ integer value | 1 | 1 |
| | HCZ | Z coordinate | M⇑ | N; m=1; M=5 | $1 \leq HCZ \leq 65534$ integer value | 1 | 1 |

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[129] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.033 | **FEC**[130] | **FEATURE CONTOURS** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 12 |
| | FCC | feature contour codes | M⇑ | A; m=4; M=16 | value from **Table 14** | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour, up to the final point - for a total of NOP pairs | | | | | |
| | HPO | horizontal pixel offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 3 | NOP |
| | VPO | vertical pixel offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 3 | NOP |
| 10.034-10.037 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 10.038 | **CMT239** | **COMMENT** | O | ANS; m=1; M=126 | None | 0 | 1 |
| 10.039 | **T10239** | **TYPE-10 REFERENCE NUMBER** | O | N; m=1; M=3 | $1 < STN < 255$ | 0 | 1 |
| 10.040 | **SMT** | **NCIC SMT CODE** | C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | AN; m=3; M=10 | Valued from **Annex D NCIC code table** | 1 | 3 |

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[130] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Occurrence count Max |
|---|---|---|---|---|---|---|---|
| 10.041 | **SMS** | **SMT SIZE** | O; C-IMT | | | 0 | 1 |
| | HGT | height | M⇑ | N; m=1; M=5[131] | $1 \leq HGT \leq VLL$ integer value | 1 | 1 |
| | WID | width | M⇑ | N; m=1; M=5239 | $1 \leq WID \leq HLL$ integer value | 1 | 1 |
| 10.042 | **SMD** | **SMT DESCRIPTORS** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[132] |
| | SMI | SMT code indicator | M⇑ | A; m=3; M=20 | value from **Table 56** | 1 | 1 |
| | TAC | tattoo class | C-IMT | A; m=4; M=8 | value from **Table 65** | 0 | 1 |
| | TSC | tattoo subclass | C-TAT | A; m=3; M=9 | value from **Table 65** | 0 | 1 |
| | TDS | tattoo description | O; C-TAT | ANS; m=1; M=13 | None | 0 | 1 |

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[131] Clarification of potential ambiguities in earlier versions of the standard.

[132] This is consistent with the 2007 version upper limit.  The 2008 version had the upper limit as unlimited.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.043 | **COL** | **TATTOO COLOR** | C-SMD | | | 0 | 1 |
| | | *Subfields:* these shall be in the same order as those of SMD . | | | | 1 | 9 |
| | | *Repeating information item* | M⇑ | A; m=3; M=7 | values from **Table 66** | 1 | 12[133] |
| 10.044 | **ITX**[134] | **IMAGE TRANSFORM** | O | | | 0 | 1 |
| | | *Subfields: Repeating values* | M⇑ | A; m=3; M=15 | values from **Table 67** | 1 | 18 |
| 10.045 | **OCC**[134] | **OCCLUSION** | O; C-IMT | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 16 |
| | FOO | face occlusion opacity | M⇑ | A; m=1; M=1 | FOO = T, I, L or S | 1 | 1 |
| | OCT | occlusion type | M⇑ | A; m=1; M=1 | FOT = H, S, C, R, or O | 1 | 1 |

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[133] This is consistent with the 2007 version upper limit.  The 2008 version only allowed one color.

[134] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 10.046-10.199 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 10.200-10.900 | **UDF** | **USER DEFINED FIELDS**[135] | O | User-defined | User-defined | | |
| 10.901 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 10.902 | **ANN239** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[136] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $GMT \leq$ Today's date and time | 1 | 1 |

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[135] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[136] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 10.903-10.994 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 10.995 | **ASC[137]** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 10.996 | **HAS[137]** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 10.997 | **SOR[137]** | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ Integer value | 0 | 1 |

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[137] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 10.998 | **GEO**[138] | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[139] | $1900 \leq$ YYYY $1 \leq$ MM $\leq 12$; $1 \leq$ DD $\leq 31$ $0 \leq$ hh $\leq 23$ $0 \leq$ mm $\leq 59$ $0 \leq$ ss $\leq 59$ All above are integer values UTE $\leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq$ LTD $\leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq$ LTM $\leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq$ LTS $\leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq$ LGD $\leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq$ LGM $\leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq$ LGS $\leq 60$ integer value | 0 | 1 |

[138] New for this version of the standard.

[139] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus.

In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000^{140} < ELE$ $< 8848.000^{141}$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 10.999 | **DATA** | **BODY PART IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

#### 8.10.1   Field 10.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

#### 8.10.2   Field 10.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-10 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

#### 8.10.3   Field 10.003: Image type / IMT

This mandatory field shall be used to indicate the type of image contained in this record. It shall contain a character string from the "Image Code" column of **Table 56** to indicate the appropriate image type. See **Field 10.042: SMT descriptors / SMD** for the use of the sub-codes.

The 2007 and 2008 versions of this standard were restricted to FACE, SCAR, MARK and TATTOO. The sub-codes for SCAR or MARK did not exist in those versions.  The cross-referencing to the NCIC codes is new for this version of the standard.

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[140] This is the lowest elevation on earth – the Dead Sea.

[141] This is the height of Mount Everest.

**Figure 7 Image of a scar**



**Figure 8 Image of a tattoo**

**Table 56 Type-10 image types**

| Image code | Image sub-codes | Comment |
|---|---|---|
| FACE | | |
| SCAR[142] | SCAR | |
| | PIERCING[143] | |
| MARK[144] | MARK | |
| TATTOO[145] | TATTOO | |
| | CHEMICAL | |
| | BRANDED | |
| | CUT | |
| FRONTAL-C | | Clothed, full body |
| REAR-C | | Clothed, full body |
| FRONTAL-N | | Naked, full body |
| REAR-N | | Naked, full body |
| TORSO-BACK | | May include head |
| TORSO-FRONT | | May include head |
| CONDITION[146] | | Close-up of feature |
| MISSING[147] | | Close-up of feature |
| OTHER[148] | | Close-up of feature |
| CHEST | | |
| FEET | | |
| HANDS-PALM | | |
| HANDS-BACK | | |
| GENITALS | | May include hips |
| BUTTOCKS | | |
| RIGHT LEG | | May include feet |
| LEFT LEG | | May include feet |
| RIGHT ARM | | May include hands |
| LEFT ARM | | May include hands |

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[142] NCIC code SC
[143] NCIC code PRCD
[144] NCIC code NM
[145] NCIC codes RTAT, TAT
[146] NCIC codes BLIND, CATA, CAUL, CLEFT, CRIP, CR0SSEYED, DIMP, DISC, EXTR, FRECKLES, FRC, HUMPBACKED, MC, M0LE, P0CKMARKS, PR0T, SHRT
[147] NCIC code category MISS (Showing the location on the body where the part would normally be)
[148] NCIC code ART, BRAC, C0L0ST, DENT, G0LD, HAIR, HEAR, IMPL, INTRA, SHUNT, SKL, SLVR, STAPLES, SUTUR, TUBE, VASC PR0T, TRANSSXL, TUBE, VASC, WIRE, 0RTH

### 8.10.4    Field 10.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.10.5    Field 10.005: Photo capture date / PCD

This mandatory field shall contain the date that the image contained in the record was captured. See **Clause 7.15.3** for details.

### 8.10.6    Field 10.006: Horizontal line length / HLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.10.7    Field 10.007: Vertical line length / VLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.10.8    Field 10.008: Scale units / SLC

This field is mandatory.  See **Clause 7.19** for details.

### 8.10.9    Field 10.009: Horizontal pixel scale / HPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.10.10  Field 10.010: Vertical pixel scale / VPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.10.11  Field 10.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted color or grayscale images. See **Table 12** for a list of the codes, and **Clauses 7.20.3** and **7.20.4** for a detailed description of this field.  The method of compression of images for Record Type-10 shall be the baseline mode of the JPEG, JPEG 200 or PNG algorithms.

### 8.10.12  Field 10.012: Color space / CSP

This is a mandatory field.  See **Clause 7.21** for details.

### 8.10.13  Field 10.013: Subject acquisition profile / SAP

The Subject Acquisition Profile (SAP) is a mandatory field when **Field 10.003: Image type / IMT**  contains "FACE".  Otherwise, it shall not be entered.   See **Clause 7.13.1.**

### 8.10.14  Field 10.014: Face image position coordinates within full image / FIP

If the face image contains more than one face, or is not cropped to a "head only" or "head and shoulders" composition, this optional field contains offsets to the location of the bounding box of the face of the subject within a larger image. This field[149] is only appropriate for images that do not comply with SAP Levels 30, 40, 50, or 51, because those images shall be cropped to a "head only" or "head and shoulders" composition.

If the image contains more than one face, the bounding box indicates the face of interest; all associated Type-10 fields are limited to the face defined by the bounding box in the larger image. This field consists of four (4) mandatory and one (1) optional information item:

• The first information item **(Left horizontal coordinate value / LHC)** is the left horizontal offset of the bounding box is relative to the origin positioned in the upper left corner of the image.  It is expressed in pixel counts across.

• The second information item **(Right horizontal coordinate value / RHC)** is the right horizontal offset of the bounding box is relative to the origin positioned in the upper left corner of the image.  It is expressed in pixel counts across.

• The third information item **(Top vertical coordinate value / TVC)** is the top vertical offset of the bounding box relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts down.

• The fourth information item **(Bottom vertical coordinate value / BVC)** is the bottom vertical offset of the bounding box relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts down.

• The fifth information item (**Bounding box code / BBC)** is the bounding box type, indicating the contents of the bounding box. If this field is omitted, the default value shall be H (Head only). If entered, the value shall be from the "Code' column of **Table 57.**

### 8.10.1    Field 10.016: Scanned horizontal pixel scale / SHPS

This is an optional field.  See **Clause 7.21** for details.

### 8.10.2    Field 10.017: Scanned vertical pixel scale / SVPS

This is an optional field.  See **Clause 7.21** for details.

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[149] New for this version of the standard.

**Table 57 Face position values**

| Code | Description |
|---|---|
| S | Head and Shoulders – the image within the bounding box is compliant with a "head and shoulders" composition (full frontal) |
| H | Head Only – the image within the bounding box is compliant with a "head only" composition |
| F | Face Only – the image within the bounding box contains a subject's two eyes, nose, and mouth |
| N | Non-Frontal Head – image within the bounding box contains the subject's entire head, but is not frontal-facing or is otherwise not compliant with a "head only" composition. |
| X | Partial face – the composition consists of a partial face, containing less than two eyes, nose, and mouth |

### 8.10.3 Field 10.018: Distortion / DIS

This optional field[150] contains the type of distortion, whether it is estimated or calculated, and its relative severity. This field consists of three information items.

- The first information item is the **Distortion code / IDK**. Allowed values are:
  - ○ "Barrel" (Image appears to be spherized or "inflated"; also known as wide angle or fisheye distortion).
  - ○ "Pincushion" (Image appears to be pinched at the center or bowed inwards).
- The second information item is an alphabetic code, which is a **Distortion measurement code / IDM**, that indicates if the distortion is estimated "E" or calculated "C".
- The third information item is the **Distortion severity code / DSC**. The allowed values are: "Mild", "Moderate" or "Severe".

### 8.10.1 Field 10.019: Lighting artifacts / LAF

This optional field[150] contains the type of lighting artifacts found in the Type-10 image record. Multiple lighting artifacts may be repeated as separate subfields. The codes are:

- F: Face shadows
- H: Hot spots
- R: Reflections from eye glasses

### 8.10.2 Field 10.020: Subject pose / POS

This optional field is to be used for the exchange of facial image data. When included, this field shall contain one character code selected from **Table 58** to describe the pose of the subject. For the determined 3D pose entry "D", **Field 10.025: Subject pose angles / SPA** shall contain a set of determined 3D pose angles (i.e., Yaw, Pitch, and Roll angles) away from the full frontal face orientation. Note that the offset angle in **Field 10.021: Pose offset angle / POA** is opposite from the yaw angle in **Field 10.025** as indicated by a minus sign.

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[150] New for this version of the standard.

**Table 58 Subject pose**

| Pose description | Pose code |
|---|---|
| Full Face Frontal | F |
| Right Profile (90 degree) | R |
| Left Profile (90 degree) | L |
| Angled Pose | A |
| Determined 3D Pose | D |

**8.10.3 Field 10.021: Pose offset angle / POA**

This shall only be used for the exchange of facial image data if **Field 10.020: Subject pose / POS** contains an "A" to indicate an angled pose of the subject. This field shall be omitted for a full face or a profile. This field specifies the pose direction of the subject at any possible orientation within a circle. Its value shall be to the nearest degree.

The offset angle shall be measured from the full-face pose position and have a range of values from -180 degrees to +180 degrees. A positive angle is used to express the angular offset as the subject rotates from a full-face pose to their left (approaching a right profile). If the entry in the POS field is an "F", "L" or "R", the contents of this field shall be ignored.

**8.10.4 Field 10.023: Photo acquisition source / PAS**

This optional field shall specify the classification of the source of the image contained in this record. This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater for face image records. (IMT=FACE only) When included, the first information item in this field shall contain a character code selected from  **Table 59** to describe the source of captured image data. See Record Type-20 to store the original reference data.

**Table 59 Acquisition source type codes**

| Acquisition source type attribute | Attribute code |
|---|---|
| Unspecified or unknown | UNSPECIFIED |
| Static photograph from an unknown source | UNKNOWN PHOTO |
| Static photograph from a digital still-image camera | DIGITAL CAMERA |
| Static photograph from a scanner | SCANNER |
| Single video frame from an unknown source | UNKNOWN VIDEO |
| Single video frame from an analog video camera | ANALOG VIDEO |
| Single video frame from a digital video camera | DIGITAL VIDEO |
| Vendor specific source | VENDOR |

The *"VENDOR"* category is used to enter unlisted or miscellaneous source attributes of the facial image. When "VENDOR" is specified, a second information item may be entered with unformatted text of up to 64 characters. It is used to describe the vendor specific source.

### 8.10.5 Field 10.024: Subject quality score / SQS

This optional field shall specify quality score data for facial images stored in this record. There may be subfields for different quality scores and algorithms. See **Clause 7.18**.

### 8.10.6 Field 10.025: Subject pose angles / SPA

This field shall be present when **Field 10.020: Subject pose / POS** contains a "D" to indicate a set of determined 3D pose angles of the same subject. Otherwise, it shall not be present. Each angle value shall be to the nearest integer degree. If the entry in the POS Field is an "F", "L", or "R", the contents of this field are ignored. When present, this information shall be entered as three or six information items. If this field is used, the first three are mandatory.

- The first information item is the Yaw angle / YAW
  (Rotation about the vertical 'y' axis).

- The second information item is the Pitch angle / PIT
  (Rotation about the horizontal 'x' axis).

- The third information item is the Roll angle / ROL (rotation about the 'z' axis).

- The fourth information item is the uncertainty in degrees for Yaw / YAWU.

- The fifth information item is the uncertainty in degrees for Pitch / PITU.

- The sixth information item is the uncertainty in degrees for Roll / ROLU.

### 8.10.1 Field 10.026: Subject facial description / SXS

This field is mandatory if the SAP entry for a facial image (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater. (IMT=FACE only)  In other cases, this field is optional for facial images. When present, it shall describe the facial expression of the subject and other attributes associated with the subject's captured facial image.

This field may have from 1 to 50 subfields. There need not be more than one subfield.  In this version, each subfield only includes one information item type (**attribute code / ATT**), which contains a single value.  It is associated with the facial image and should be selected from the "Attribute code" column of **Table 60** and entered in this field.  For "Physical Characteristic", enter a characteristic as listed in the NCIC code.  See **Annex D NCIC code table**.

**Table 60 Subject facial description codes**

| Facial description attribute | Attribute code |
|---|---|
| Expression unspecified | UNKNOWN |
| Neutral (non-smiling) with both eyes open and mouth closed) | NEUTRAL |
| Smiling where the inside of the mouth and/or teeth is not exposed (closed jaw). | SMILE |
| Subject having mouth open | MOUTH OPEN |
| Having teeth visible | TEETH VISIBLE |
| Raising eyebrows | RAISED BROWS |
| Frowning | FROWNING |
| Looking away from the camera | EYES AWAY |
| Squinting | SQUINTING |
| Subject wearing left eye patch | LEFT EYE PATCH |
| Subject wearing right eye patch | RIGHT EYE PATCH |
| Subject wearing clear glasses | CLEAR GLASSES |

| Facial description attribute | Attribute code |
|---|---|
| Subject wearing dark or visible colored glasses (medical) | DARK GLASSES |
| Head covering/hat | HAT |
| Wearing scarf | SCARF |
| Having mustache | MOUSTACHE |
| Having beard | BEARD |
| Ear(s) obscured by hair | NO EAR |
| Blinking (either or both eyes closed) | BLINK |
| Having distorting medical condition impacting feature point detection | DISTORTING CONDITION |
| Physical characteristics | &lt;From Annex D&gt; |
| Other characteristics | &lt;Unformatted Alphabetic Text, up to 20 characters&gt; |

### 8.10.2  Field 10.027: Subject eye color / SEC

This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater. For other facial images, the field is optional.  When present, it shall describe the eye color of the subject as seen in the photograph.  If unknown, unusual or unnatural such as may be the case when colored contact lenses are present and the "real" eye color cannot be ascertained, then the color should be labeled as "XXX". Eye color attributes and attribute codes are given by **Table 20**.  See **Clause 7.25** for further information.

### 8.10.3  Field 10.028: Subject hair color / SHC

This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater.  For other facial images, it is optional. When present, it shall contain one or two entries from **Table 61** that describes the hair color of the subject as seen in the photograph.  For unusual or unnatural colors not listed in the table, or the "real" color cannot be ascertained, the hair color should be labeled as "XXX".  If the subject is completely bald, or has a completely shaved head, then the hair color shall be labeled as "BAL".  When the subject is predominantly bald, but hair color is discernible, then the appropriate hair color attribute code shall follow "BAL" in a second entry.  If a person has multiple hair colors (such as blue in the middle and orange on the sides), select one color for the first entry and the other for the second. For streaked hair, use "STR" in the first entry; use the second entry to describe the principal color of the hair.  There need not be more than one entry.

**Table 61 Hair color codes**

| Hair color attribute | Attribute code |
|---|---|
| Unspecified or unknown | XXX |
| Bald | BAL |
| Black | BLK |
| Blonde or Strawberry | BLN |
| Brown | BRO |
| Gray or Partially Gray | GRY |
| Red or Auburn | RED |
| Sandy | SDY |
| White | WHI |
| Blue | BLU |
| Green | GRN |
| Orange | ONG |
| Pink | PNK |
| Purple | PLE |
| Streaked | STR |

**8.10.4    Field 10.029: 2D Facial feature points / FFP**

The optional field shall be used for the exchange of facial image data feature points or landmarks. When present, it shall describe special attributes of manually or automatically detected facial feature points of the captured facial image. This information shall be entered as a four-information item feature point block in a repeating subfield. Multiple facial points may be listed using these information items, each in a separate subfield. The maximum number of feature points is 88. This field does not contain a Z coordinate, unlike **Field 10.032: Anthropometric 3D facial feature points/ AFF**.

- The first information item, **Feature point type / FPT** is a one character value. It is mandatory. It shall be either

    - o   1 = Denoting an MPEG4 Feature point.

    - o   2 = Anthropometric landmark. (This is new to this version).

- The second information item, **Feature point code / FPC** is 3 to 5 characters. If FPT is 1, this information item shall be "A.B" with A and B defined in **Clause 8.10.4.1** and illustrated in **Figure 10.** If FPT is 2, the codes are entered as shown in the "Feature Point ID" column of **Table 63.** This is one to three alphabetic characters.

- The third information item is the **X coordinate / HCX.** It is 1 to 5 characters, denoting the pixel count horizontally to the right from the upper left pixel, which is set to 0.

- The fourth information item is the **Y coordinate / HCY.** It is 1 to 5 characters, denoting the pixel count vertically down from the upper left pixel, which is set to 0.

### 8.10.4.1  MPEG4 2D Feature points

The **feature point code / FPC** item shall specify the feature point that is stored in the feature point block. For 2D features (FPT = 1), the codes for the feature points are taken from the MPEG4 standard and defined as MPEG4 feature points. Each feature point code is represented by a notation A.B using a major (A) and a minor (B) value. The encoding of the feature point code is given by the numeric ASCII representation of the value of A.B. The period is required, and the maximum size of this entry shall be 5 characters.

**Figure 10** denotes the feature point codes associated with feature points as given by Annex C of *ISO/IEC 14496-2*. Each code is given by major value A and minor value B. For example, the code for the left corner of the left eye is given by major value 3 and minor value 7. "A" specifies the global landmark of the face to which this landmark belongs, such as nose, mount, etc. "B" specifies the particular point. In case a Landmark Point has two symmetrical entities (left and right) the right entity always has a greater and even minor code value. Landmark points from the left part of the face have odd minor codes, and those from the right part have even minor codes. Both A and B are in the range from 1 to 15.

### 8.10.4.2  Eye and nostril center Feature Points

The eye center feature points 12.1 (left) and 12.2 (right) are defined to be the horizontal and vertical midpoints of the eye corners (3.7, 3.11) and (3.8, 3.12) respectively. The left nostril center feature point 12.3 is defined to be the midpoint of the nose feature points (9.1, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction. Similarly, the right nostril

center feature point 12.4 is defined to be the midpoint of the nose feature points (9.2, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction.  Both the eye center and nostril center Feature points are shown in **Figure 9** and values are given in **Table 62**.
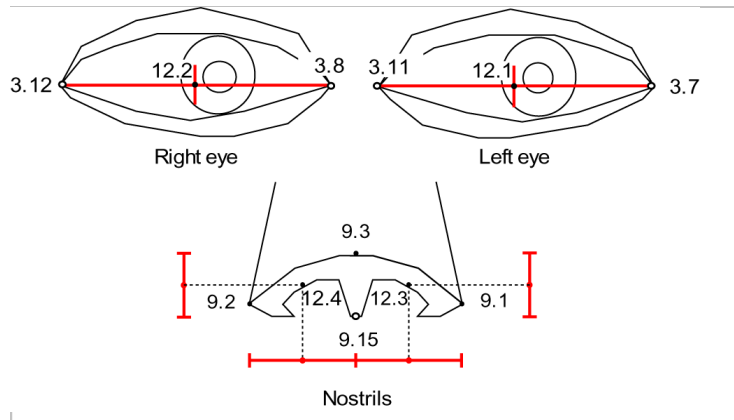


**Figure 9 Eye and nostril center feature points**

**Table 62 Eye and nostril center feature point codes**

| Center Feature Point | Midpoint of Feature Points | | Feature Point code |
|---|---|---|---|
| Left Eye | 3.7, 3.11 | | 12.1 |
| Right Eye | 3.8, 3.12 | | 12.2 |
| Left Nostril | Horizontal | Vertical | 12.3 |
| | 9.1, 9.15 | 9.3,9.15 | |
| Right Nostril | Horizontal | Vertical | 12.4 |
| | 9.2, 9.15 | 9.3,9.15 | |

**Figure 10 Feature point codes defined in ISO/IEC 14496-2**

### 8.10.4.3 *Anthropometric landmarks with and without MPEG4 counterparts*

This clause[151] uses the definitions specified by ISO[152]. Anthropometric landmarks extend the MPEG4 feature model with points that are used in forensics and anthropology for person identification via two facial images or image and skull. They also allow specification of points that are in use by criminal experts and anthropologists. **Figure 11**[153] and **Table 63** show the definition of the anthropometric landmarks. The set of points represents the craniofacial landmark points of the head and face. The latter are used in forensics for "Face to face" and "Skull to face" identification. They are entered in **Field 10.032: Anthropometric 3D facial feature points/ AFF** in the FPC information item. Some of these points have MPEG 4 counterparts, others not. The error of an anthropometric 3D landmark point location should be no greater than 3mm. The point on the surface is a vertex, or a point on an edge, or a point on a face of the surface.
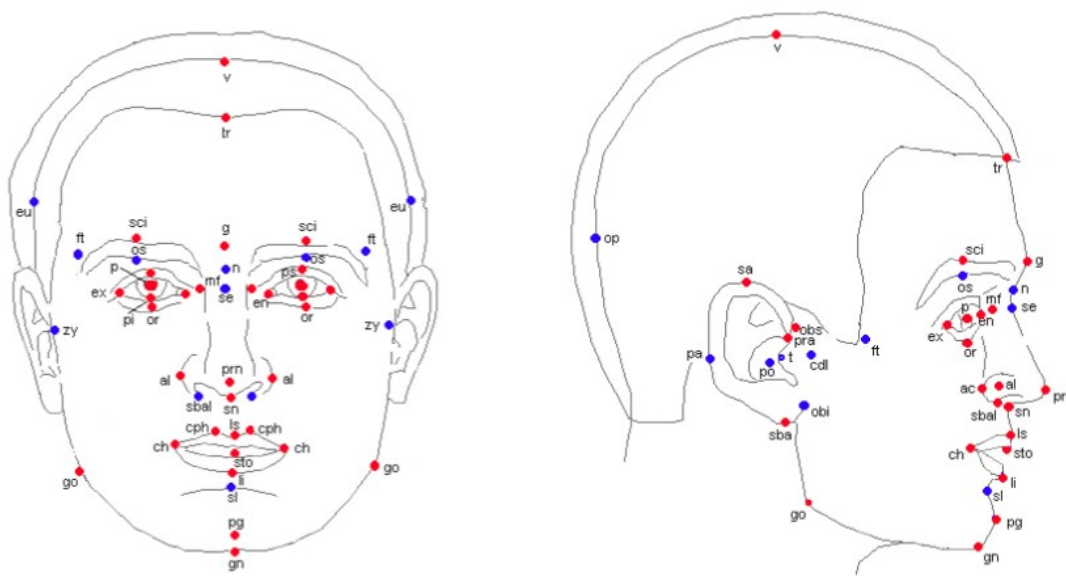


**Figure 11 Anthropometric facial landmarks defined in ISO/IEC 19794-5**

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[151] New for this version of the standard.

[152] See ISO/IEC 19794-5 *Information technology – Biometric data interchange formats – Part 5: Face image data*, Clause 5.5.6 Anthropometric Landmarks.

[153] Red landmarks denote with MPEG4 counterparts and blue without MPEG4 counterparts.

## Table 63 ISO Definitions of the Anthropometric landmarks

| Feature Point ID | MPEG4 Feature Point | Anthropometric Point Name | Description |
|---|---|---|---|
| v | 11.4 | vertex | The highest point of head when the head is oriented in Frankfurt Horizon. |
| g | | glabella | The most prominent middle point between the eyebrows |
| op | | opisthocranion | Situated in the occipital region of the head is most distant from the glabella |
| eu | | eurion | The most prominent lateral point on each side of the skull in the area of the parietal and temporal bones |
| ft | | frontotemporale | The point on each side of the forehead, laterally from the elevation of the linea temporalis |
| tr | 11.1 | trichion | The point on the hairline in the midline of the forehead |
| y | | zygion | The most lateral point of each of the zygomatic |
| go | 2.15 2.16 | gonion | The most lateral point on the mandibural angle close to the bony gonion |
| sl | | sublabiale | Determines the lower border of the lower lip or the upper border of the chin |
| pg | 2.10 | pogonion | The most anterior midpoint of the chin, located on the skin surface in the front of the identical bony landmark of the mandible |
| gn | 2.1 | menton (or gnathion) | The lowest median landmark on the lower border of the mandible |
| cdl | | condylion laterale | The most lateral point on the surface of the condyle of the mandible |
| en | 3.11 3.8 | endocanthion | The point at the inner commissure of the eye fissure |
| ex | 3.7 3.12 | exocanthion (or ectocanthion) | The point at the outer commissure of the eye fissure |

| Feature Point ID | MPEG4 Feature Point | Anthropometric Point Name | Description |
|---|---|---|---|
| p | 3.5 3.6 | center point of pupil | Is determined when the head is in the rest position and the eye is looking straight forward |
| or | 3.9 3.10 | orbitale | The lowest point on the lower margin of each orbit |
| ps | 3.1 3.2 | palpebrale superius | The highest point in the mid-portion of the free margin of each upper eyelid |
| pi | 3.3 3.4 | palpebrale inferius | The lowest point in the mid-portion of the free margin of each lower eyelid |
| os | | orbitale superius | The highest point on the lower border of the eyebrow |
| sci | 4.3 4.4 | superciliare | The highest point on the upper border in the mid-portion of each eyebrow |
| n | | nasion | The point in the middle of both the nasal root and nasofrontal suture |
| se | | sellion (or subnasion) | Is the deepest landmark located on the bottom of the nasofrontal angle |
| al | 9.1 9.2 | alare | The most lateral point on each alar contour |
| prn | 9.3 | pronasale | The most protruded point of the apex nasi |
| sn | 9.15 | subnasale | The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet |
| sbal | | subalare | The point at the lower limit of each alar base, where the alar base disappears into the skin of the upper lip |
| ac | 9.1 9.2 | alar curvature (or alar crest) point | The most lateral point in the curved base line of each ala |
| mf | 9.6 9.7 | maxillofrontale | The base of the nasal root medially from each endocanthion |

| Feature Point ID | MPEG4 Feature Point | Anthropometric Point Name | Description |
|---|---|---|---|
| cph | 8.9 8.10 | christa philtri landmark | The point on each elevated margin of the philtrum just above the vermilion line |
| ls | 8.1 | labiale (or labrale) superius | The midpoint of the upper vermillion line |
| li | 8.2 | labiale (or labrale) inferius | The midpoint of the lower vermillion line |
| ch | 8.3 8.4 | cheilion | The point located at each labial commissure |
| sto | | Stomion | The imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips, with teeth shut in the natural position |
| sa | 10.1 10.2 | superaurale | The highest point of the free margin of the auricle |
| sba | 10.5 10.6 | subaurale | The lowest point of the free margin of the ear lobe |
| pra | 10.9 10.10 | preaurale | The most anterior point on the ear, located just in front of the helix attachment to the head |
| pa | | postaurale | The most posterior point on the free margin of the ear |
| obs | 10.3 10.4 | otobasion superious | The point of attachment of the helix in the temporal region |
| obi | | otobasion infrious | The point of attachment of the ear lobe to the cheek |
| po | | porion (soft) | The highest point of the upper margin of the cutaneous auditory meatus |
| t | | tragion | The notch on the upper margin of the tragus |

### 8.10.5 Field 10.030: Device monitoring mode / DMM

This field is optional. See **Clause 7.17.**

### 8.10.6 Field 10.031: Tiered markup collection / TMC

This optional field[154] describes the specific facial feature points contained in **Field 10.029: 2D Facial feature points / FFP** and if level 5, contours shall be contained in **Field 10.033: Feature contours / FEC**. It is selected from the "Value" column of **Table 64.**

**Table 64 Tiered Markup Collections (frontal)**

| Value | Facial feature points/Contours | Description |
|---|---|---|
| 1 | Eye centers | 2D Feature Points:<br>Centers of eyes: 12.1 and 12.2 |
| 2 | Eyes, mouth | 2D Feature Points:<br>Centers of eyes: 12.1 and 12.2<br>Center of mouth: sto |
| 3 | Eyes, nose, mouth | 2D Feature Points for:<br>Corners of eyes: 3.7, 3.11, 3.8, 3.12<br>Bridge and tip of nose: Se, 9.3<br>Corners of mouth: 8.3, 8.4 |
| 4 | Eyes, nose, mouth, and head | 2D Feature Points for:<br>Corners of eyes: 3.7, 3.11, 3.8, 3.12<br>Pupils: 3.5, 3.6<br>Edges of nostrils: 9.4, 9.5<br>Corners of mouth: 8.3, 8.4<br>Tops and bottoms of ears: 10.1, 10.5, 10.2, 10.6<br>Chin: 2.1<br>Top of head and/or hair:  11.4, 11.5 |

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[154] New for this version of the standard.

| Value | Facial feature points/Contours | Description |
|---|---|---|
| 5 | Facial feature points and contours for eyes, brows, nose, mouth and face outline | Top of upper lip contour<br>Bottom of lower lip contour<br>Left and right eyebrow contours<br>Left and right eye contours<br>Chin contour<br>2D Feature Points for:<br><br>Left and right eyes: 3.7, 3.11, 12.1, 3.8, 3.12, 12.2<br><br>Nose: 9.1, 9.2, 9.3, 9.15<br><br>Mouth corners: 8.3, 8.4<br><br>Ear tops and bottoms: 10.1, 10.5, 10.2, 10.6 |
| 6-99 | Reserved | Reserved for future use |
| 100-999 | User defined | User defined |

### 8.10.7   Field 10.032: Anthropometric 3D facial feature points/ AFF

The optional field[155] shall be used for the exchange of facial image data feature points or landmarks. When present, it shall describe special attributes of manually or automatically detected facial feature points of the captured facial image. This information shall be entered as a four-information item feature point block in a subfield. Multiple facial points may be listed using these information items, each in a separate subfield. The maximum number of feature points is 88.  This field contains a Z coordinate, unlike **Clause 8.10.4**, which is solely a 2D set of feature points.

- The first information item, **Feature point type / FPT** is a one character value.  It is mandatory.  It shall be either:

    o   1 = Denoting an MPEG4 Feature point, but using an Z coordinate.

    o   2 = Anthropometric landmark, with a Z coordinate.

- The second information item, **Feature point code / FPC** is 3 to 5 characters.  If FPT is 1, this information item shall be "A.B" with A and B defined in **Clause 8.10.4.1.** and illustrated in **Figure 10.** If FPT is 2, the codes are entered as shown in the "Feature Point ID" column of **Table 63.** Note that this entry is one to three

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[155] New for this version of the standard.

alphabetic characters.

- The third information item is the **X coordinate / HCV.** It is 1 to 5 characters, denoting the pixel count from the upper left pixel, which is set to 0.

- The fourth information item is the **Y coordinate / HCY.** It is 1 to 5 characters, denoting the pixel count from the upper left pixel, which is set to 0.

- The fifth information item is the **Z coordinate / HCZ.** It is 1 to 5 characters, denoting the pixel count from the upper left pixel, which is set to 0.

The metric coordinates of 3D landmarks shall be obtained by multiplying the X, Y, and Z coordinates by a fixed scale of 0.02 mm.

### 8.10.1  Field 10.033: Feature contours / FEC

Each subfield (See **Clause 7.23)** refers to a specific contour and contains a minimum of three points.[156]

### 8.10.2  Field 10.038: Comment / CMT

This is an optional field239.  See **Clause 7.8.**

### 8.10.3  Field 10.039: Type-10 reference number / T10

This is an optional field[156].  It is used when several images cover either the entire SMT or portions of it.  The same T10 is used when referring to a particular image.   This field shall not used if there are no multiple images of the same SMT or body part in the transaction.

### 8.10.4  Field 10.040: NCIC SMT code / SMT

This field shall be used only when **Field 10.003: Image type / IMT** = "SCAR", "MARK", or "TATTOO". It is not used for other images. It is used to identify a general location of the captured scar, mark, tattoo, or other characteristic (including piercings) in an image.  The contents of this field shall be from the NCIC code (See **Annex D**).  The captured image may encompass an area larger than that specified by a single NCIC body part code for the particular image type.   This situation may be accommodated by listing multiple NCIC codes, each in a separate information item entry.  In this case the primary code is listed first. There need not be more than one subfield.

For the "marks" category, the NCIC manual lists the common locations for needle track marks.  For other body part locations not listed under the "marks" category, use the body location codes listed for scars.

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[156] New for this version of the standard.

**8.10.5    Field 10.041: SMT size / SMS**

This optional field shall contain the dimensions of the portion of scar, mark or tattoo contained in this record (it may be the entire scar, mark or tattoo).  It shall consist of two information items: **Height / HGT** and **Width / WID**. Each dimension shall be entered to the nearest centimeter. This field shall be used only when **Field 10.003: Image type / IMT**  = "SCAR", "MARK", or "TATTOO".

**8.10.6    Field 10.042: SMT descriptors / SMD**

This optional field is used to describe the content of the SMT image to an extent greater than documented in **Field 10.040: NCIC SMT code / SMT**.  It shall consist of one or more repeating sets of information items (**Scar mark tattoo data / SDT**).  Each repeating subfield shall contain three or four information items that provide progressively detailed information describing the total image or a portion of the image. This field shall be used only when **Field 10.003: Image type / IMT** = "SCAR", "MARK", or "TATTOO".

- The first information item **(SMT Code Indicator / SMI)** shall identify the source of the image as being a scar, a mark, or a tattoo.  It shall contain *"SCAR"* to indicate healed scar tissue that was the result an accident or medical procedure. *"PIERCING"* is a deliberately made hole through body tissue, usually to wear body ornamentation.  An entry of *"MARK"* shall be used for the pattern resulting from needle or track marks. For deliberately applied or drawn images, the first information item shall contain *"TATTOO"* to indicate a common tattoo or indelible image resulting from the pricking of the skin with a coloring matter; *"CHEMICAL"* if the image was created by the use of chemicals to burn the image into the skin; *"BRANDED"* if the image was burned into the skin using a branding iron or other form of heat; or  *"CUT"* if the image was caused by incision of the skin. The value for this information item is selected from the "Image sub-code" column of **Table 56**.[157]

- The second information item **(Tattoo class / TAC)** shall be the general class code of tattoo chosen from the "Class code" column of **Table 65**. This does not apply to scars and marks.

- The third information item **(Tattoo subclass / TSC)** shall be the appropriate subclass code selected from the "Code" column of **Table 65** that lists the various subclasses of tattoos for each of the general classes. For each general class of tattoo, there are several defined subclasses.  This does not apply to scars and marks.

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[157] Piercing has been added as a subcategory for this version of the standard.

- The fourth (optional) information item (**Tattoo description / TDS**) shall be a text string that provides additional qualifiers to describe the image or portion of the image. For example, to fully describe a tattoo, there may be a class description of "ANIMAL", with a subclass description of "DOG", and qualified by "golden retriever with an overbite".

An SMT image consisting of several parts or sub-images shall use subfields to fully describe the various parts or features found in the total image. The first subfield shall describe the most predominant feature or sub-image contained in the SMT image. Subsequent repeating subfields shall describe additional portions of the image that are not part of the main or central focal point of the image. For example, a tattoo consisting of a man with a snake on the arm being followed by a dog may contain three subfields - one describing the man, a second describing the snake, and a third describing the dog.

**Table 65 Tattoo classes and subclasses**

| Class | Subclass | Code | | Class | Subclass | Code |
|-------|----------|------|---|-------|----------|------|
| HUMAN | | | | ANIMAL | | |
| | Male Face | MFACE | | | Cats & Cat Heads | CAT |
| | Female Face | FFACE | | | Dogs & Dog Heads | DOG |
| | Abstract Face | ABFACE | | | Other Domestic Animals | DOMESTIC |
| | Male Body | MBODY | | | Vicious Animals (Lions, etc.) | VICIOUS |
| | Female Body | FBODY | | | Horses (Donkeys, Mules, etc.) | HORSE |
| | Abstract Body | ABBODY | | | Other Wild Animals | WILD |
| | Roles (Knight, Witch, man, etc.) | ROLES | | | Snakes | SNAKE |
| | Sports Figures (Football Player, Skier, etc.) | SPORT | | | Dragons | DRAGON |
| | Male Body Parts | MBPART | | | Birds (Cardinal, Hawk, etc.) | BIRD |
| | Female Body Parts | FBPART | | | Spiders, Bugs, and Insects | INSECT |
| | Abstract Body Parts | ABBPART | | | Abstract Animals | ABSTRACT |
| | Miscellaneous Human Forms | MHUMAN | | | Animal Parts | PARTS |
| | Skulls | SKULL | | | Miscellaneous Animal Forms | MANIMAL |

| Class | Subclass | Code | | Class | Subclass | Code |
|---|---|---|---|---|---|---|
| PLANT | | | | FLAG | | |
| | Narcotics | NARCOTICS | | | American Flag | USA |
| | Red Flowers | REDFL | | | State Flag | STATE |
| | Blue Flowers | BLUEFL | | | Nazi Flag | NAZI |
| | Yellow Flowers | YELFL | | | Confederate Flag | CONFED |
| | Drawings of Flowers | DRAW | | | British Flag | BRIT |
| | Rose | ROSE | | | Miscellaneous Flags | MFLAG |
| | Tulip | TULIP | | | | |
| | Lily | LILY | | | | |
| | Misc. Plants, Flowers, Veg. | MPLANT | | | | |

| Class | Subclass | Code | | Class | Subclass | Code |
|---|---|---|---|---|---|---|
| OBJECT | | | | ABSTRACT | | |
| | Fire | FIRE | | | Figure(s) | FIGURE |
| | Weapons (Guns, Arrows, etc.) | WEAP | | | Sleeve | SLEEVE |
| | Airplanes and other Air vehicles (incl. Blimps) | PLANE | | | Bracelet | BRACE |
| | Boats, Ships, & Other Water Vessels | VESSEL | | | Anklet | ANKLET |
| | Trains | TRAIN | | | Necklace | NECKLC |
| | Cars, Trucks, and other Land Vehicles (except Trains) | VEHICLE | | | Shirt | SHIRT |
| | Mythical (Unicorns, etc.) | MYTH | | | Body Band | BODBND |
| | Sporting Objects (Football, Ski, Hurdles, etc.) | SPORT | | | Head Band | HEDBND |
| | Water & Nature Scenes (Rivers, Sky, Trees, etc.) | NATURE | | | Miscellaneous Abstract | MABSTRACT |
| | Miscellaneous Objects | MOBJECTS | | | | |

### 8.10.7  Field 10.043: Tattoo Color / COL

This optional field shall contain one subfield corresponding to each subfield contained in **Field 10.042: SMT descriptors / SMD**. Each subfield shall contain entries that list the color(s) of the tattoo or part of the tattoo. For each entry, the first one shall be the predominant color chosen from **Table 66**. Additional colors shall be entered as subsequent entries. There need not be more than one entry.

**Table 66 Tattoo color codes**

| Color description | Color code |
|---|---|
| Black | BLACK |
| Brown | BROWN |
| Gray | GRAY |
| Blue | BLUE |
| Green | GREEN |
| Orange | ORANGE |
| Purple | PURPLE |
| Red | RED |
| Yellow | YELLOW |
| White | WHITE |
| Multi-colored | MULTI |
| Outlined | OUTLINE |

### 8.10.8  Field 10.044: Image transform / ITX

This optional field[158] is used in the case when the image in this Type-10 record has been transformed from the original image. Note that the untransformed image(s) (optionally) may be included in a Type-20 record. The information item in this field may be repeated if multiple transforms were performed.

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[158] New for this version of the standard.

**Table 67  Image transform values**

| Value | Description |
|---|---|
| AGE | Age progressed |
| AXIS | Offaxis image rectification / Angle correction |
| COLORSHIFT | Color shifted |
| CONTRAST | Contrast stretched |
| CROP | Cropped |
| DIST | Distortion corrected (e.g. fisheye correction) |
| DOWNSAMPLE | Down-sampled |
| GRAY | Grayscale from color |
| ILLUM | Illumination transform |
| IMGFUSE | Image-level fusion of two or more images |
| INTERPOLATE | Up-sampled |
| MULTCOMP | Multiply compressed |
| MULTIVIEW | Multiview image |
| POSE | Face-specific pose correction |
| ROTATE | Rotated (in-plane) |
| SNIR | Simulated Near IR |
| SUPERRES | Super-resolution image, derived from multiple lower resolution images |
| WHITE | White balance adjusted |

**8.10.9   Field 10.045: Occlusion / OCC**

This optional field[158] defines the outline and contents of any occlusions that partially or totally blocks the image of the face. For details on entering data for this Field, see **Clause 7.23.**  This field has a subfield that may be repeated for each combination of entries in the following two tables. The first information item contains the alphabetic code from **Table 18** and the second information item contains the alphabetic code from **Table 19**.

### 8.10.10  Field 10.200-900: User-defined fields / UDF

The size and content of these fields shall be defined by the user and be in accordance with the receiving agency.[159]

### 8.10.11  Fields 10.902: Annotated Information / ANN

This is an optional field[160], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type.  See **Clause 7.5.**

### 8.10.12  Field 10.995: Associated context / ASC

This optional field[160] refers to one or more Record Type-21 with the same ACN.  See **Clause 7.4.**

### 8.10.13  Field 10.996: Hash/ HAS

This optional field[160]  shall contain the hash value of the image in  **Field 10.999: Body part image / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.10.14  Field 10.997: Source representation / SOR

This optional field[160] refers to a representation in Record Type-20 with the same SRN.

### 8.10.15   Field 10.998: Geographic sample acquisition location / GEO

This optional field[160] contains the location where the image was acquired – not where it is stored.  See **Clause 7.7**.

### 8.10.16   Field 10.999: Body part image / DATA

This mandatory field contains the image. See **Clause 7.8** for details on the Data field entry.  In Traditional encoding, this shall be the last physical field in the record.

## 8.11  Record Type-11: Reserved for voice

## 8.12  Record Type-12: Reserved for dental records

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[159] The 2007 version of the standard restricted these fields to ASCII text.  This version of the standard allows the alternate character encoding set specified by the user in Field 1.015 to apply, which is consistent with the 2008 version of the standard.

[160] New for this version of the standard.

## 8.13  Record Type-13: Friction-ridge latent image record

The Type-13 record shall contain image data acquired from latent captures of friction ridge images[161].  These images may be used by agencies that will automatically extract or provide human intervention and processing to extract the desired feature information from the images.  Information regarding the scanning resolution used, the image size, and other parameters required to process the image, are recorded as fields within the record.

**Table 68 Type-13 record layout[162]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 13.001 | | RECORD HEADER | M | | | 1 | 1 |
| 13.002 | IDC | INFORMATION DESIGNATION CHARACTER | M | N; m=1;M= 3[163] | $0 \leq IDC \leq 255$[164] | 1 | 1 |

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[161] With the addition of Record Type-19, this field can also apply to latent plantar prints.

[162] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional for the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[163] The maximum was 4 in the 2007 version, but it has been reduced to 3 since the maximum value of IDC is 255.

[164] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC.  However, it was never explicitly mentioned in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 13.003 | **IMP** | **IMPRESSION TYPE** | M | N; m=1;M=2[165] | $4 \leq IMP \leq 7$<br>$12 \leq IMP \leq 15$ or<br>$32 \leq IMP \leq 35239$<br>integer value | 1 | 1 |
| 13.004[166] | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 13.005 | **LCD** | **LATENT CAPTURE DATE** | M | Dependent upon encoding[167] | $1900 \leq YYYY$<br>$1 \leq MM \leq 12$<br>$1 \leq DD \leq 31$<br>All above are integer values<br>$LCD \leq$ Today's date | 1 | 1 |
| 13.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; m=2; M=5[168] | $1 \leq HLL \leq 99999$<br>integer value | 1 | 1 |

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[165] The maximum in the 2007 version was 1 character. However, since palm codes are 2 characters and plantar codes has two characters, the maximum was increased in the version.

[166] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

[167] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

[168] The minimum was 3 and the maximum 4 in the 2007 version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 13.007 | **VLL** | **VERTICAL LINE LENGTH** | M | N; m=2; M=5 | $1 \leq VLL \leq 99999$ integer value | 1 | 1 |
| 13.008 | **SLC** | **SCALE UNITS** | M | N; m=1; M=1 | SLC = 0, 1 or 2 | 1 | 1 |
| 13.009 | **HPS** | **HORIZONTAL PIXEL SCALE** | M | N; m=1; M=4 | integer value | 1 | 1 |
| 13.010 | **VPS** | **VERTICAL PIXEL SCALE** | M | N; m-1; M=4 | integer value | 1 | 1 |
| 13.011 | **CGA** | **COMPRESSION ALGORITHM** | M | A; m=3; M=5 | value from **Table 12** | 1 | 1 |
| 13.012 | **BPX** | **BITS PER PIXEL** | M | N; m=1; M=2 | Integer value | 1 | 1 |
| 13.013 | **FPP** | **FRICTION RIDGE POSSIBLE POSITION** | M | | | 1 | 1 |
| | | *Subfields: Repeating values* | | N; m=1; M=2 | Integer values from **Table 4** | 1 | 6 |
| 13.014 | **SPD** | **SEARCH POSITION DESCRIPTORS** | C-FGP | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9 |
| | PDF | probable decimal finger position code | M⇑ | N; m=1; M=2 | Integer values from **Table 4** | 1 | 1 |
| | FIC | finger image code | M⇑ | AN; m=3; M=3 | FIC = EJI, FV1, FV2, FV3 or FV4 | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 13.015 | **PPC** | **PRINT POSITION COORDINATES** | C-FGP | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 12 |
| | FVC | number of the full finger view | M⇑ | AN; m=3; M=3 | FVC = TIP, FV1, FV2, FV3 or FV4 | 1 | 1 |
| | LOS | location of a segment | M⇑ | AN; m=2; M=3 | LOS = NA, PRX, DST or MED | 1 | 1 |
| | LHC | left horizontal coordinate | M⇑ | N; m=1; M=5 | $1 \leq LHC \leq HLL$ integer value | 1 | 1 |
| | RHC | right horizontal coordinate | M⇑ | N; m=1; M=5 | $1 \leq RHC \leq HLL$ integer value | 1 | 1 |
| | TVC | top vertical coordinate | M⇑ | N; m=1; M=5 | $1 \leq TVC \leq VLL$ integer value | 1 | 1 |
| | BVC | bottom vertical coordinate | M⇑ | N; m=1; M=5 | $1 \leq BVC \leq VLL$ integer value | 1 | 1 |
| 13.016 | **SHPS** | **SCANNED HORIZONTAL PIXEL SCALE** | O | N; m=1; M=4 | integer value | 0 | 1 |
| 13.017 | **SVPS** | **SCANNED VERTICAL PIXEL SCALE** | O | N; m=1; M=4 | integer value | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | | | | | | | |
| 13.018-13.019 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 13.020 | **COM** | **COMMENT** | O | ANS; m=1; M=126 | None[169] | 0 | 1 |
| 13.021-13.023 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 13.024 | **LQM** | **LATENT QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[170] |
| | FRC | friction ridge code | M⇑ | N; m=1; M=2 | integer values from **Table 4** | 1 | 1 |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or $QVU = 254$ or $255$ integer value | 1 | 1 |
| | QAV | algorithm vendor ID | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 13.025-13.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

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[169] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[170] The upper limit was 4 in the 2007 version of the standard. It has been set to 9 for consistency across record types and encodings of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 13.200-13.900 | **UDF** | **USER DEFINED FIELDS** | O | User-defined | User-defined[171] | | |
| 13.901 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |
| 13.902 | **ANN** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[172] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values GMT $\leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 13.903-13.994 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |

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[171] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[172] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 13.995 | **ASC**[173] | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 13.996 | **HAS**[173] | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 13.997 | **SOR239** | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ Integer value | 0 | 1 |
| 13.998 | **GEO239** | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |

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[173] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[174] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $UTE \leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |

[174] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | ELE | elevation | O | N; m-1; M=8 | -422.000 < ELE < 8848.000 <br> real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ <br> integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ <br> real number | 0 | 1 |
| 13.999 | **DATA** | **LATENT FRICTION RIDGE IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

### 8.13.1   Field 13.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.13.2   Field 13.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-13 record  in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

### 8.13.3   Field 13.003: Impression type / IMP

This mandatory field shall indicate the manner by which the plantar print was obtained. See **Clause 7.9** for details. Valid values are 4 through 7, 12 through 15, and 32 through 35.

### 8.13.4   Field 13.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.13.5   Field 13.005: Latent capture date / LCD

This mandatory field shall contain the date that the palm biometric data contained in the record was captured. See **Clause 7.15.3** for details.

### 8.13.6   Field 13.006: Horizontal line length / HLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.7   Field 13.007: Vertical line length / VLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.8   Field 13.008: Scale units / SLC

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.9   Field 13.009: Horizontal pixel scale / HPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.10   Field 13.010: Vertical pixel scale / VPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.11   Field 13.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.1** for a detailed description of this field.

### 8.13.12   Field 13.012: Bits per pixel / BPX

This field is mandatory.  See **Clause 7.19** for details.

### 8.13.13   Field 13.013: Friction ridge probable position / FPP

This field is mandatory.   Each subfield shall contain one possible finger, palm or plantar position they may match the latent image, up to a maximum of 6 possibilities. The code "0" shall be used to reference every finger position from 1 to 10.  The code" 20" for "Unknown palm" shall be used to reference every listed palmprint position.  The code "60" for "Unknown sole" shall be used for every listed plantar position.[175]  Code "19" shall be used to reference one or more parts of an EJI or tip. See **Clause 7.10** and **Table 4** for details.  There need not be more than one subfield.

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[175] New for this version of the standard – to allow for plantar prints.

### 8.13.14  Field 13.014: Search position descriptors / SPD

This field shall be present if and only if the finger position code "19" appears in **Field 13.013: Friction ridge probable position / FPP**. The first information item is the **probable decimal finger position code / PDF** taken from **Table 4.**

The second information item is **finger image code / FIC.** Latent images of full-length fingers use codes FV1 through FV3, as described in **Clause 7.11**. Note that the EJI code is used for the case when all four finger images are to be considered (FV1, FV2, FV3, and FV4). For the case when the latent is to be compared to proximal, distal or medial segments of a finger, the information item FIC shall contain the appropriate finger segment. Multiple portions of the EJI may be listed, each as a subfield with the same value for PDF and a different value for FIC. There need not be more than one subfield.

### 8.13.15  Field 13.015: Print position coordinates / PPC

This field shall be present if and only if the finger position code "19" appears in **Field 13.013: Friction ridge probable position / FPP**. Individual full finger or segment definitions may be entered as separate subfields. See **Clause 7.12** for details. For the case of a fingertip, the first information item shall be "TIP", and the second information item shall be "NA". The next four information items (offsets) are as described in **Clause 7.12.**

### 8.13.16  Field 13.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Clause 7.19** for details.

### 8.13.17  Field 13.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Clause 7.19** for details.

### 8.13.18  Field 13.020: Comment / COM

This is an optional field. See **Clause 7.22** for details.

### 8.13.19  Field 13.024: Latent quality metric / LQM

This optional field is used to specify one or more different metrics of latent image quality score data for the image stored in this record. Each subfield is comprised of four information items. The first information shall be the **friction ridge code / FRC** for the image stored in this record. See **Table 4.** See **Clause 7.18** for a description of the remaining three information items.

### 8.13.20  Fields 13.200 – 13.900 : User defined fields / UDF

These fields shall be defined by the user.  Their size and content shall be in accordance with the receiving agency.

### 8.13.21  Field 13.902: Annotated Information / ANN

This is an optional field[176], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type.  See **Clause 7.5**

### 8.13.22  Field 13.995: Associated context / ASC

This optional field[176] refers to one or more Record(s) Type-21. See **Clause 7.4.**

### 8.13.23  Field 13.996: Hash/ HAS

This optional field[176] shall contain the hash value of the image in **Field 13.999: Latent friction ridge image / DATA**, calculated using SHA 256. See **Clause 7.6**.

### 8.13.24  Field 13.997: Source representation / SOR

This optional field[176] refers to a representation in Record Type-20 with the same SRN.

### 8.13.25  Field 13.998: Geographic sample acquisition location / GEO

This optional field[176] contains the location where the latent sample was acquired – not where it is stored.  See **Clause 7.7**.

### 8.13.26  Field 13.999: Latent friction ridge image / DATA

This mandatory field contains the latent image. See **Clause 7.8** for details on the Data field entry.  In Traditional encoding, this shall be the last physical field in the record.

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[176] New for this version of the standard.

## 8.14   Record Type-14: Fingerprint image record (preferred format)

The Type-14 record shall contain and be used to exchange exemplar fingerprint image data, such as a rolled tenprint, an identification flat, or a complete friction ridge exemplar.  All fingerprint impressions shall be acquired from a card, a single or multiple-finger flat-capture device, contactless fingerprint sensor that outputs 2D fingerprint images[177], or a live-scan device.  Captured images may be transmitted to agencies that will automatically extract the desired feature information from the images for matching purposes.  Textual information regarding the scanning resolution, the image size and other parameters or comments required to process the image are recorded as fields within the record.

The Type-14 record is also used to exchange identification flats of multiple fingers (simultaneous plain impressions captured on a platen). Two of the image record codes contain the left and right simultaneous four fingers, and a third contains the two thumbs. There are also codes for two and three and four finger combinations. Offsets to the locations of image segments containing the individual fingers are included with the image records for individual flat prints resulting from segmentation of a four-finger slap image.

This standard allows simultaneous capture of fingerprint images from adjacent platens if the relative position of the fingers is maintained and has fidelity to the subject's finger orientations and relative length.  Simultaneous capture of multiple fingers from non-adjacent platens is also allowed, but should be separately transmitted.  **Field 14.026: Simultaneous capture  / SCF** has been added as an optional field to this version of the standard to specifically indicate that the images were simultaneously captured. However, the individual images from such a capture shall not be stitched together to create a single four-finger slap image.[178] Additional fields are defined to contain the NIST Fingerprint Image Quality (NFIQ) metric, alternate image quality metrics, and metrics for predicting the correctness of the segmentation.

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[177] Clarification that this standard does not include a 3D fingerprint image format.

[178] Clarification of potential ambiguities in earlier versions of the standard.

**Table 69 Type-14 record layout[179]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.001 | | RECORD HEADER | M | | | 1 | 1 |
| 14.002 | IDC | INFORMATION DESIGNATION CHARACTER | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$[180] | 1 | 1 |
| 14.003 | IMP | IMPRESSION TYPE | M | N; m=1;M=2[181] | $0 \leq IMP \leq 3$ <br> IMP = 8, 10 or 11 <br> $20 \leq IMP \leq 31$ <br> integer value | 1 | 1 |
| 14.004[182] | ORG | ORIGINATING AGENCY | M | | | 1 | 1 |
| | ORI | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | OAN | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |

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[179] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[180] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

[181] The 2007 version of the standard only allowed 1 character.

[182] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.005 | **FCD** | **FINGERPRINT CAPTURE DATE** | M | Dependent upon encoding[183] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $FCD \leq$ Today's date | 1 | 1 |
| 14.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; m=3; M=4 | $1 \leq HLL \leq 99999$ integer value | 1 | 1 |
| 14.007 | **VLL** | **VERTICAL LINE LENGTH** | M | N; m=3; M=4 | $1 \leq VLL \leq 99999$ integer value | 1 | 1 |
| 14.008 | **SLC** | **SCALE UNITS** | M | N; m=1; M=1 | $0 \leq SLC \leq 2$ integer value | 1 | 1 |
| 14.009 | **HPS** | **HORIZONTAL PIXEL SCALE** | M | N; m=1; M=4 | integer value | 1 | 1 |
| 14.010 | **VPS** | **VERTICAL PIXAL SCALE** | M | N; m-1; M=4 | integer value | 1 | 1 |
| 14.011 | **CGA** | **COMPRESSION ALGORITHM** | M | A; m=3; M=5 | value from **Table 12** | 1 | 1 |
| 14.012 | **BPX** | **BITS PER PIXEL** | M | N; m=1; M=2 | Integer value | 1 | 1 |
| 14.013 | **FPP** | **FRICTION RIDGE POSSIBLE POSITION** | M | | | 1 | 1 |
| | | *Subfields: Repeating values* | M | N; m=1; M=2 | $0 \leq FGP \leq 10$ or $FGP = 19$ | 1 | 6 |
| 14.014 | **PPD** | **PRINT POSITION DESCRIPTORS** | C-FGP | | | 0 | 1 |
| | PDF | probable decimal finger position code | M⇑ | N; m=1; M=2 | $0 \leq PDF \leq 10$ | 1 | 1 |
| | FIC | finger image code | M⇑ | N; m=1; M=2 | value from **Table 5** | 1 | 1 |

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[183] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.015 | **PPC** | **PRINT POSITION COORDINATES** | C-FGP | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 12 |
| | FVC | number of the full finger view | M⇑ | AN; m=3; M=3 | FVC = FV1, FV2, FV3, FV4 or TIP | 1 | 1 |
| | LOS | location of a segment | M⇑ | AN; m=3; M=3 | LOS = NA, PRX, DST or MED | 1 | 1 |
| | LHC | left horizontal coordinate | M⇑ | AN; m=2; M=5 | $1 \leq LHC \leq HLL$ integer value | 1 | 1 |
| | RHC | right horizontal coordinate | M⇑ | N; m=1; M=5 | $1 \leq RHC \leq HLL$ integer value | 1 | 1 |
| | TVC | top vertical coordinate | M⇑ | N; m=1; M=5 | $1 \leq TVC \leq VLL$ integer value | 1 | 1 |
| | BVC | bottom vertical coordinate | M⇑ | N; m=1; M=5 | $1 \leq BVC \leq VLL$ integer value | 1 | 1 |
| 14.016 | **SHPS** | **SCANNED HORIZONTAL PIXEL SCALE** | O | N; m=1; M=5 | positive integer value | 0 | 1 |
| 14.017 | **SVPS** | **SCANNED VERTICAL PIXEL SCALE** | O | N; m=1; M=4 | positive integer value | 0 | 1 |
| 14.018 | **AMP** | **AMPUTATED OR BANDAGED** | O | N; m=1; M=4 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4 |
| | FGP | finger number | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | FMC | amputated or bandaged code | M⇑ | A; m=2; M=2 | FMC = XX or UP | 1 | 1 |
| 14.019 | **RSV** | **RESERVED FOR FUTURE USE** | O | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.020 | **COM** | **COMMENT**[184] | O | ANS; m=1; M=126 | None | 0 | 1 |
| 14.021 | **SEG** | **FINGERPRINT SEGMENT POSITION** | M | | | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4[185] |
| | FGP | finger position number | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | LHC | left horizontal coordinate value | M⇑ | N; m=1; M=4 | $1 \leq LHC \leq HLL$ integer value | 1 | 1 |
| | RHC | right horizontal coordinate value | M⇑ | N; m=1; M=4 | $1 \leq RHC \leq HLL$ integer value | 1 | 1 |
| | TVC | top vertical coordinate value | M⇑ | N; m=1; M=4 | $1 \leq TVC \leq VLL$ integer value | 1 | 1 |
| | BVC | bottom vertical coordinate value | M⇑ | N; m=1; M=4 | $1 \leq BVC \leq VLL$ integer value | 1 | 1 |
| 14.022 | **NQM** | **NIST QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4 |
| | FGP | finger number | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | IQS | NIST image quality score | M⇑ | N; m=1; M=1 | $1 \leq IQS \leq 5$ | 1 | 1 |
| | NFV | NFIQ version | O⇑ | N; m-1;M-2 | $1 \leq NFV \leq 99$ Integer value | 0 | 1 |

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[184] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[185] This was unlimited in the 2007 version, but since only four fingers can be segmented in on image, it is set to 4 in this version.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.023 | **SQM** | **SEGMENTATION QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[186] |
| | FGP | finger number | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or QVU = 254 or 255 integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 14.024 | **FQM** | **FINGERPRINT QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[186] |
| | FRC | friction ridge code | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or QVU = 254 or 255 integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 14.025 | **ASEG** | **ALTERNATE FINGER SEGMENT POSITION(S)** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4 |

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[186] This was unrestricted in the 2007 version of the standard. It has been set to 9 to conform to the other record types and to ensure consistency in all encodings.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | FGP | friction ridge generalized position | M⇑ | N; m=1; M=2 | $1 \leq FGP \leq 10$ | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 1 | 1 |
| | HPO | horizontal (x) pixel offset | M⇑ | N; m=1; M=5 | $1 \leq HOP \leq HLL$ integer value | 1 | 1 |
| | VPO | vertical (y) pixel offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 1 | 1 |
| 14.026 | **SCF**[187] | **SIMULTANEOUS CAPTURE** | O | N; m=1, M=3 | $1 \leq SCF \leq 255$ | 0 | 1 |
| 14.027-14.029 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 14.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=8; M=10 | Value from **Table 10** | 1 | 1 |
| 14.031 | **SAP**[187] | **SUBJECT ACQUISITION PROFILE** | O | N; m=2; M=2 | SAP = 10,20,30,40,50 or 60 | 0 | 1 |
| 14.032-14.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 14.200 – 14.900 | **UDF** | **USER DEFINED FIELDS** | O | User defined | User-defined[188] | | |
| 14.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 14.902 | **ANN**[187] | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |

[187] New for this version of the standard.

[188] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[189] | $1900 \leq YYYY$<br>$1 \leq MM \leq 12;$<br>$1 \leq DD \leq 31$<br>$0 \leq hh \leq 23$<br>$0 \leq mm \leq 59$<br>$0 \leq ss \leq 59$<br>All above are integer values<br>$GMT \leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |

[189] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.903-14.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 14.995 | **ASC**[190] | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 14.996 | **HAS**[190] | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 14.997 | **SOR**[190] | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ integer value | 0 | 1 |

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[190] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 14.998 | **GEO[191]** | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[192] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values UTE $\leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |

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[191] New for this version of the standard.

[192] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | ELE | elevation | O | N; m-1; M=8 | -422.000 < ELE < 8848.000 real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 14.999 | **DATA** | **FINGERPRINT IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

### 8.14.1    Field 14.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.14.2    Field 14.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-14 record as found in **Field 1.003 Transaction content / CNT** of the Type-1 record.  See **Clause 7.2.**

### 8.14.3    Field 14.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint image was obtained.  See **Clause 7.9** for details.

### 8.14.4    Field 14.004: Source agency / ORI / SRC

This is a mandatory field. See **Clause 7.16** for details.

### 8.14.5    Field 14.005: Fingerprint capture date / FCD

This mandatory field shall contain the date that the fingerprint data contained in the record was captured. See **Clause 7.15.3** for details.

**8.14.6    Field 14.006: Horizontal line length / HLL**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.7    Field 14.007: Vertical line length / VLL**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.8    Field 14.008: Scale units / SLC**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.9    Field 14.009: Horizontal pixel scale / HPS**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.10  Field 14.010: Vertical pixel scale / VPS**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.11  Field 14.011: Compression algorithm / CGA**

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.1** for a detailed description of this field.

**8.14.12  Field 14.012: Bits per pixel / BPX**

This field is mandatory.  See **Clause 7.19** for details.

**8.14.13  Field 14.013: Friction ridge generalized position / FGP**

This field is mandatory.  See **Clause 7.10** for details.

**8.14.14  Field 14.014: Print position descriptors / PPD**

This field shall be present if and only if the finger position code "19" appears in **Field 14.013: Friction ridge generalized position / FGP**. See **Clause 7.11** for details.

**8.14.15  Field 14.015: Print position coordinates / PPC**

This field shall be present if and only if the finger position code "19" appears in **Field 14.013: Friction ridge generalized position / FGP**. See **Clause 7.12** for details.

**8.14.16  Field 14.016: Scanned horizontal pixel scale / SHPS**

This is an optional field.  See **Clause 7.19** for details.

**8.14.17   Field 14.017: Scanned vertical pixel scale / SVPS**

This is an optional field.  See **Clause 7.19** for details.

**8.14.18   Field 14.018: Amputated or bandaged / AMP**

This optional field shall specify if one or more fingers are amputated or bandaged.  This field shall consist of one subfield for each amputated or missing finger.  Each subfield shall contain two information items.

The first item is the **Finger number / FGP** between one and ten as chosen from **Table 4**.

The second item is the **Amputated or bandaged code / FMC,** also known as the AMPCD. **Table 70** is a list of allowable indicators for the AMPCD.

**Table 70 Amputation / bandaged fingerprinting codes**

| Descriptor | AMPCD |
|---|---|
| Amputation | XX |
| Unable to print (e.g., bandaged) | UP |

Multiple amputated or unprintable finger positions may each be entered as a separate repeating subfield.  This field is to be used anytime there are fewer than expected printable fingers in a submission (e.g., less than four in a left or right slap or less than two in a two-thumb slap).  A partially scarred finger should be printed.

**8.14.19   Field 14.020: Comment / COM**

This is an optional field.  See **Clause 7.22** for details.

**8.14.20   Field 14.021: Finger segment position(s) / SEG**

This mandatory field shall contain offsets to the locations of image segments containing the individual fingers within the flat images of simultaneous fingers from each hand or the two simultaneous thumbs. (FGP = 13,14,15 or 40-50 from **Table 4** as entered in **Field 14.013: Friction ridge generalized position / FGP**).

The subfield occurs at least once, and may be repeated if more than one algorithm is used to segment the image. Each subfield contains five information items.

- The first information item is the **Finger position number / FGP** with values of  1 to 10 selected from **Table 4**.

- The second information item is the **Left horizontal coordinate value / LHC**.  It is the horizontal offset in pixels to the right relative to the origin positioned in the upper left corner of the image.

- The third information item is the **Right horizontal coordinate value / RHC**. It is the horizontal offset in pixels to the right relative to the origin positioned in the upper left corner of the image.

- The fourth information item is the **Top vertical coordinate value / TVC** is the vertical offset (pixel counts down) to the top of the bounding box.

- The fifth information item is the **Bottom vertical coordinate value / BVC**. It is the vertical offset from the upper left corner of the image down to the bottom of the bounding box.  It is counted in pixels.

### 8.14.1   Field 14.022: NIST quality metric / NQM

This optional field shall contain the NIST Fingerprint Image Quality (NFIQ) scores for the individual finger(s) derived from the slap impressions or individual rolled fingerprints.  It consists of two information items.

- The first item is the **Finger number / FGP** between one and ten as chosen from **Table 4.**

- The second item is the **NIST image quality score / IQS** which is a quantitative expression of the predicted AFIS matcher accuracy performance of the fingerprint image.  The scores range from "1" for the best quality image, to "5" for the worst quality image.  A "254" indicates that no score was ever computed while an entry of "255" shall indicate a failed attempt to calculate the image quality metric.

- The third item[193] is the **NFIQ version / NFV** which is a positive integer value, with version 1 as the default assumed value if the item is not entered.

### 8.14.1   Field 14.023: Segmentation quality metric / SQM

This optional field provides a measure of estimated correctness regarding the accuracy of the location of the segmented finger within the right or left four finger image or two thumb image.  A subfield shall exist for each segmented finger.  Each subfield consists of four information items.

The first information item is the **Finger number / FGP** between one and ten as chosen from **Table 4**. See **Clause 7.18.**

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[193] New for this version of the standard.

### 8.14.2　Field 14.024: Fingerprint quality metric / FQM

This optional field shall specify one or more different metrics of fingerprint image quality score data for the image stored in the record.  A subfield shall exist for each segmented finger in the image. Each subfield consists of four information items.

The first information item is the **Finger number / FGP** between one and ten as chosen from **Table 4**.  For information on the remaining three information items, see **Clause 7.18.**

### 8.14.3　Field 14.025: Alternate finger segment position(s) / ASEG

This optional field is an alternate approach to describing the locations for each of the image segments of up to four individual fingers within a flat image containing the capture of four simultaneous fingers or two simultaneous thumbs. This field uses an n-vertex polygon to encompass each finger image segment, where "n" is between 3 and 99. A minimum of three points is required to describe a finger location.  The order of the vertices shall be in their consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. No two vertices may occupy the same location. The polygon side defined by the last vertex and the first vertex shall complete the polygon. The polygon shall be a simple, plane figure with no sides crossing and no interior holes.

This field shall consist of up to four subfields: the segmentation for each finger is represented in a different subfield. The first information item (**Finger position code / FPC**) is the finger number from **Table 4**.   See **Clause 7.23**. The number of information items within each subfield depends on the number of vertices.

### 8.14.4　Field 14.026: Simultaneous capture  / SCF

This optional field[194] allows the user to link together fingerprint images that were captured simultaneously.  Note that this is different from the IDC.  This is used, for instance, when individual flat print are captured on different platens simultaneously. Such images shall not be stitched together for transmission as a single multiple-finger print image, but they may be coded with the same SCF value to indicate that they were captured simultaneously, and that there is little possibility of a mistaken fingerprint code.

### 8.14.5　Field 14.030: Device monitoring mode / DMM

This is an optional field.  See **Clause 7.17** for details.

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[194] New for this version of the standard.

### 8.14.6 Field 14.031: Subject acquisition profile / SAP

This optional field[195] lists the SAP levels associated with fingerprint acquisition devices. See **Clause 7.13.3** for details.

### 8.14.7 Field 14.800-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.14.8 Fields 14.902: Annotated Information / ANN

This is an optional field[195], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Clause 7.5.**

### 8.14.9 Field 14.995: Associated context / ASC

This optional field[195] refers to one or more Record Type-21 with the same ACN.

### 8.14.10 Field 14.996: Hash/ HAS

This optional field[195] shall contain the hash value of the image in **Field 14.999: Fingerprint image / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.14.11 Field 14.997: Source representation / SOR

This optional field[195] refers to a representation in Record Type-20 with the same SRN.

### 8.14.12 Field 14.998: Geographic sample acquisition location / GEO

This optional field[195] contains the location where the fingerprint sample was acquired – not where it is stored. See **Clause 7.7**.

### 8.14.13 Field 14.999: Fingerprint image / DATA

This mandatory field contains the fingerprint image. See **Clause 7.8** for details on the Data field entry. In Traditional encoding, this shall be the last physical field in the record.

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[195]New for this version of the standard.

## 8.15   Record Type-15: Palmprint image record

The Type-15 record shall contain and be used to exchange palmprint image data together with fixed and user-defined textual information fields pertinent to the digitized image. Information regarding the scanning resolution used, the image size, and other parameters or comments required to process the image are recorded as fields within the record. Palmprint images transmitted to other agencies will be processed by the recipient agencies to extract the desired feature information required for matching purposes.

The image data shall be acquired directly from a subject using a live-scan device, a palmprint card, a major case print card, or other media that contains the subject's palmprints.

Any method used to acquire the palmprint images shall be capable of capturing a set of images for each hand. This set shall include the writer's palm as a single scanned image, and the entire area of the full palm extending from the wrist bracelet to the tips of the fingers as one or two scanned images. If two images are used to represent the full palm, the lower image shall extend from the wrist bracelet to the top of the interdigital area (third finger joint) and shall include the thenar, and hypothenar areas of the palm. The upper image shall extend from the bottom of the interdigital area to the upper tips of the fingers. This provides an adequate amount of overlap between the two images. The standard also has provision for encoding the interdigital, thenar, and hypothenar areas separately for each palm. By matching the ridge structure and details contained in this common area, an examiner may confidently state that both images came from the same palm.

As a palmprint transaction may be used for different purposes, it may contain one or more unique image areas recorded from the palm or hand. A complete palmprint record set for one individual will normally include the writer's palm and the full palm image(s) from each hand. A single Type-15 record will be required for each writer's palm and one to three Type-15 records for each full palm. Four to eight Type-15 records will be required to represent the subject's palmprints in a normal palmprint transaction.

## Table 71 Type-15 record layout[196]

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 15.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 15.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 < IDC < 255$[197] | 1 | 1 |
| 15.003 | **IMP** | **IMPRESSION TYPE** | M | N; m=2;M=2 | IMP = 10 or 11 | 1 | 1 |
| 15.004[198] | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 15.005 | **PCD** | **PALMPRINT CAPTURE DATE** | M | Dependent upon encoding[199] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $PCD \leq$ Today's date | 1 | 1 |

[196] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[197] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

[198] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

[199] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 15.006 | HLL | HORIZONTAL LINE LENGTH | M | N; m=3; M=4 | $1 \leq HLL \leq 99999$ integer value | 1 | 1 |
| 15.007 | VLL | VERTICAL LINE LENGTH | M | N; m=3; M=4 | $1 \leq VLL \leq 99999$ integer value[200] | 1 | 1 |
| 15.008 | SLC | SCALE UNITS | M | N; m=1; M=1 | $0 \leq SLC \leq 2$ integer value | 1 | 1 |
| 15.009 | HPS | HORIZONTAL PIXEL SCALE | M | N; m=1; M=4 | integer value | 1 | 1 |
| 15.010 | VPS | VERTICAL PIXAL SCALE | M | N; m-1; M=4 | integer value | 1 | 1 |
| 15.011 | CGA | COMPRESSION ALGORITHM | M | AN; m=3; M=5 | value from **Table 12** | 1 | 1 |
| 15.012 | BPX | BITS PER PIXEL | M | N; m=1; M=2 | integer value | 1 | 1 |
| 15.013 | FGP | FRICTION RIDGE GENERALISE POSITION (PALMPRINT POSITION) | M | N; m=2; M=2 | $20 \leq value \leq 38$ | 1 | 1 |
| 15.014-15.015 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 15.016 | SHPS | SCANNED HORIZONTAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 15.017 | SVPS | SCANNED VERTICAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 15.018-15.019 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 15.020 | COM | COMMENT | O | ANS; m=1; M=126 | None[201] | 0 | 1 |
| | | | | | | | |

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[200] Clarification of potential ambiguities in earlier versions of the standard.

[201] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 15.021-15.023 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 15.024 | **PQM** | **PALM QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[202] |
| | FRC | friction ridge code | M⇑ | N; m=1; M=2 | $20 \leq FRC \leq 38$ | 1 | 1 |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or QVU = 254 or 255 integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 15.025-15.029 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 15.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=8; M=10 | Value from **Table 11** | 1 | 1 |
| 15.031-15.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 15.200 – 15.900 | **UDF** | **USER DEFINED FIELDS** | O | User defined | User defined[203] | | |
| 15.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

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[202] The 2007 version of the standard stated a maximum of 4. This version state a maximum of 9 for consistency across record types and encodings.

[203] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 15.902 | **ANN²⁰⁴** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding²⁰⁵ | $1900 \leq YYYY$; $1 \leq MM \leq 12$; $1 \leq DD \leq 31$; $0 \leq hh \leq 23$; $0 \leq mm \leq 59$; $0 \leq ss \leq 59$; All above are integer values; $GMT \leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 15.903-15.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 15.995 | **ASC²⁰⁴** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |

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²⁰⁴ New for this version of the standard.

²⁰⁵ In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".  In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 15.996 | **HAS**[206] | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 15.997 | **SOR**[206] | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ Integer value | 0 | 1 |
| 15.998 | **GEO**[206] | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[207] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $UTE \leq$ Today's date and time | 1 | 1 |

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[206] New for this version of the standard.

[207] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 15.999 | **DATA** | **PALM IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

### 8.15.1 Field 15.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.15.2 Field 15.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-15 record as found **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

### 8.15.3    Field 15.003: Impression type / IMP

This mandatory field shall indicate the manner by which the palm print was obtained. See **Clause 7.9** for details.

### 8.15.4    Field 15.004: Source agency / ORI / SRC

This is a mandatory field. See **Clause 7.16** for details.

### 8.15.5    Field 15.005: Palmprint capture date / PCD

This mandatory field shall contain the date that the palm biometric data contained in the record was captured. See **Clause 7.15.3** for details.

### 8.15.6    Field 15.006: Horizontal line length / HLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.15.7    Field 15.007: Vertical line length / VLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.15.8    Field 15.008: Scale units / SLC

This field is mandatory.  See **Clause 7.19** for details.

### 8.15.9    Field 15.009: Horizontal pixel scale / HPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.15.10  Field 15.010: Vertical pixel scale / VPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.15.11  Field 15.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.1** for a detailed description of this field.

### 8.15.12  Field 15.012: Bits per pixel / BPX

This field is mandatory.  See **Clause 7.19** for details.

**8.15.13   Field 15.013: Friction ridge generalized position (Palmprint position) / FGP**

This mandatory field shall contain the palm print position that matches the palmprint image.  Valid codes range from 20 to 38.  See **Table 4**.  See **Clause 7.10** for details.

**8.15.14   Field 15.016: Scanned horizontal pixel scale / SHPS**

This is an optional field.  See **Clause 7.19** for details.

**8.15.15    Field 15.017: Scanned vertical pixel scale / SVPS**

This is an optional field.  See **Clause 7.19** for details.

**8.15.16   Field 15.020: Comment / COM**

This is an optional field.  See **Clause 7.22** for details.

**8.15.17   Field 15.024: Friction ridge -Palmprint print quality metric / FQM**

This optional field is used to specify one or more different metrics of the print image quality score data for the image stored in this record. Each subfield is comprised of four information items.   The first information shall be the **friction ridge code / FRC** for the image stored in this record. Valid codes range from 20 to 38.  See **Table 4.**   See **Clause 7.18** for a description of the remaining three information items.

**8.15.18   Field 15.030: Device monitoring mode / DMM**

This is an optional field.  See **Clause 7.17** for details.

**8.15.19   Fields 15.200-900: User-defined fields / UDF**

These fields are user-defined fields.  Their size and content shall be defined by the user and be in accordance with the receiving agency.

**8.15.20   Fields 15.902: Annotated Information / ANN**

This is an optional field[208], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type.  See **Clause 7.5.**

**8.15.21   Field 15.995: Associated context / ASC**

This optional field[208] refers to one or more Record(s) Type-21 with the same ACN. See

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[208] New for this version of the standard.

**Clause 7.4.**

### 8.15.22  Field 15.996: Hash/ HAS

This optional field[209] shall contain the hash value of the image in **Field 15.999: Palm image / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.15.23  Field 15.997: Source representation / SOR

This optional field[209] refers to a representation in Record Type-20 with the same SRN. See **Clause 7.3.**

### 8.15.24  Field 15.998: Geographic sample acquisition location / GEO

This optional field[209] contains the location where the palm sample was acquired – not where it is stored.  See **Clause 7.7**.

### 8.15.25  Field 15.999: Palm image / DATA

This mandatory field contains the palm image. See **Clause 7.8** for details on the Data field entry.  In Traditional encoding, this shall be the last physical field in the record.

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[209] New for this version of the standard.

## 8.16 Record Type-16: User-defined testing image record

The Type-16 record shall contain and be used to exchange image data together with textual information fields pertinent to the digitized image. This record type allows the standard to provide the ability to exchange images not addressed by other record types in the standard. It is intended as the user-defined record to be used for developmental or test purposes.

The image data contained in the Type-16 record may be in a compressed form. With the exception of the fields described below, the format, parameters, and types of images to be exchanged are undefined by this standard and shall be agreed upon between the sender and recipient.

**Table 72 Type-16 record layout[210]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 16.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 16.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$[211] | 1 | 1 |
| 16.003 | **UDI** | **USER-DEFINED IMAGE** | M | N; m=1;M=35 | User-defined | 1 | 1 |

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[210] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[211] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 16.004[212] | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 16.005 | **UTD** | **USER-DEFINED TESTING DATE** | M | Dependent upon encoding[213] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $UTD \leq$ Today's date | 1 | 1 |
| 16.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; m=2; M=5 | $1 \leq HLL \leq 99999$ integer value[214] | 1 | 1 |
| 16.007 | **VLL** | **VERTICAL LINE LENGTH** | M | N; m=2; M=5 | $1 \leq VLL \leq 99999$ integer value[214] | 1 | 1 |
| 16.008 | **SLC** | **SCALE UNITS** | M | N; m=1; M=1 | $0 \leq SLC \leq 2$ integer value | 1 | 1 |
| 16.009 | **HPS** | **HORIZONTAL PIXEL SCALE** | M | N; m=1; M=4 | integer value | 1 | 1 |
| 16.010 | **VPS** | **VERTICAL PIXAL SCALE** | M | N; m-1; M=4 | integer value | 1 | 1 |
| 16.011 | **CGA** | **COMPRESSION ALGORITHM** | M | AN; m=3; M=5 | Value from **Table 12** | 1 | 1 |
| 16.012 | **BPX** | **BITS PER PIXEL** | M | N; m=1; M=2 | integer value | 1 | 1 |

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[212] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

[213] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

[214] Clarification of potential ambiguities in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Occurrence count Max |
|---|---|---|---|---|---|---|---|
| 16.013 | CSP | COLOR SPACE | O | A; m=3; M=4 | Values from **Table 13** | 1 | 1 |
| 16.014-16.015 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 16.016 | SHPS | SCANNED HORIZONTAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 16.017 | SVPS | SCANNED VERTICAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 16.018-16.019 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 16.020 | COM | COMMENT[215] | O | ANS; m=1; M=126 | None | 0 | 1 |
| 16.021-16.023 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 16.024 | UQS | USER-DEFINED TESTING IMAGE QUALITY SCORES | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[216] |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or qvu = 254 or 255 integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |

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[215] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[216] The upper limit was 1 in the 2007 version of the standard. It has been set to 9 for consistency across record types and encodings of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 16.025-16.029 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 16.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=8; M=10 | Value from **Table 11** | 1 | 1 |
| 16.031-16.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 16.200 – 16.900 | **UDF** | **USER DEFINED FIELDS** | O | User defined | User defined [217] | | |
| 16.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 16.902 | **ANN** | **ANNOTATED INFORMATION[218]** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[219] | $1900 \leq YYYY$ <br> $1 \leq MM \leq 12$; <br> $1 \leq DD \leq 31$ <br> $0 \leq hh \leq 23$ <br> $0 \leq mm \leq 59$ <br> $0 \leq ss \leq 59$ <br> All above are integer values <br> GMT $\leq$ Today's date and time | 1 | 1 |

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[217]The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

[218] New for this version of the standard

[219] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 16.991-16.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 16.995 | **ASC** | **ASSOCIATED CONTEXT[220]** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \le ACN \le 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \le ASP \le 99$ integer value | 0 | 1 |
| 16.996 | **HAS** | **HASH[220]** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 16.997 | **SOR** | **SOURCE REPRESENTATION[220]** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \le SRN \le 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \le RTV \le 99$ Integer value | 0 | 1 |

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[220] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 16.998 | **GEO** | GEOGRAPHIC SAMPLE ACQUISITION LOCATION[221] | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[222] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values UTE $\leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |

[221]New for this version of the standard.

[222] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus.
In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | ELE | elevation | O | N; m-1; M=8 | -422.000 < ELE < 8848.000 real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 16.999 | **DATA** | **TEST DATA** | M | B; m=1; M=* | None | 1 | 1 |

### 8.16.1    Field 16.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.16.2    Field 16.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-16 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

### 8.16.3    Field 16.003: User-defined image type / UDI

This mandatory field shall contain the type of user-defined mage contained in this record. Its content shall be defined by the user and be in accordance with the receiving agency.

### 8.16.4    Field 16.004: Source agency / ORI / SRC

This is a mandatory field. See **Clause 7.16** for details.

### 8.16.5    Field 16.005: User-defined image test capture date / UTD

This mandatory field shall contain the date that the test image contained in the record was captured. See **Clause 7.15.3** for details.

### 8.16.6    Field 16.006: Horizontal line length / HLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.7    Field 16.007: Vertical line length / VLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.8    Field 16.008: Scale units / SLC

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.9    Field 16.009: Horizontal pixel scale / HPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.10   Field 16.010: Vertical pixel scale / VPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.11   Field 16.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.1** for a detailed description of this field.

### 8.16.12   Field 16.012: Bits per pixel / BPX

This field is mandatory.  See **Clause 7.19** for details.

### 8.16.13   Field 16.013: Color space / CSP

This optional field shall be completed in accordance with **Clause 7.21.3** if entered.

### 8.16.14   Field 16.016: Scanned horizontal pixel scale / SHPS

This is an optional field.  See **Clause 7.19** for details.

### 8.16.15    Field 16.017: Scanned vertical pixel scale / SVPS

This is an optional field.  See **Clause 7.19** for details.

### 8.16.16   Field 16.020: Comment / COM

This is an optional field.  See **Clause 7.22** for details.

### 8.16.17   Field 16.024: User-defined image quality metric / FQM

This optional field is used to specify one or more different metrics of the image quality

score data for the image stored in this record. Each subfield is comprised of three information items. See **Clause 7.18** for a description of the three information items.

### 8.16.18 Field 16.030: Device monitoring mode / DMM

This is an optional field. See **Clause 7.17** for details.

### 8.16.19 Fields 16.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.16.20 Field 16.902: Annotated Information / ANN

This is an optional field[223], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Clause 7.5**

### 8.16.21 Field 16.995: Associated context / ASC

This optional field[223] refers to one or more Record(s) Type-21 with the same ACN.

### 8.16.22 Field 16.996: Hash/ HAS

This optional field[223] shall contain the hash value of the image in **Field 16.999: Test data / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.16.23 Field 16.997: Source representation / SOR

This optional field[223] refers to a representation in Record Type-20 with the same SRN. See **Clause 7.3.**

### 8.16.24 Field 16.998: Geographic sample acquisition location / GEO

This optional field[223] contains the location where the sample was acquired – not where it is stored. See **Clause 7.7**.

### 8.16.25 Field 16.999: Test data / DATA

This mandatory field contains the user-defined test image. See **Clause 7.8** for details on the Data field entry. In Traditional encoding, this shall be the last physical field in the record.

## 8.17  Record Type-17: Iris image record

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[223] New for this version of the standard.

The Type-17 record shall contain and be used to exchange generic iris image data using mandatory fields of this record type. Optional fields may be used to exchange additional information available in the *INCITS 379-2004 – Iris Image Interchange Format standard* and the *ISO/IEC 19794-6 iris image data interchange format standard*. Images may be monochrome or color with 256 or more intensity levels (gray or per-color component), and vary in size depending on field of view and compression.

The iris standard specifies interchange formats for biometric authentication systems that utilize iris recognition. The formats all store sampled pixel data from rectilinear images. The data shall be encoded as a raw array of intensity values, a raw array of red green blue color values, or as losslessly compressed or lossy-compressed versions thereof. Two of the formats are specialized for small record sizes; these are achieved by cropping and masking the images to support efficient compression (see **Field 17.032: Iris storage format / ISF**).

**Table 73 Type-17 record layout[224]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 17.001 | | RECORD HEADER | M | | | 1 | 1 |
| 17.002 | IDC | IMAGE DESIGNATION CHARACTER | M | N; m=1; M=3 | $0 \leq IDC \leq 255$[225] | 1 | 1 |

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[224] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[225] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 17.003 | **ELR** | **EYE LABEL** | M | N; m=1; M=1 | ELR = 0, 1 or 2 | 1 | 1 |
| 17.004[226] | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 17.005 | **ICD** | **IRIS CAPTURE DATE** | M | Dependent upon encoding[227] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $PHD \leq$ Today's date | 1 | 1 |
| 17.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M | N; m=2; M=5 | $1 \leq HLL \leq 99999$ integer value[228] | 1 | 1 |
| 17.007 | **VLL** | **VERTICAL LINE LENGTH** | M | N; m=2; M=5 | $1 \leq VLL \leq 99999$ integer value[228] | 1 | 1 |
| 17.008 | **SLC** | **SCALE UNITS** | M | N; m=1; M=1 | $0 \leq SLC \leq 2$ integer value | 1 | 1 |
| 17.009 | **HPS** | **HORIZONTAL PIXEL SCALE** | M | N; m=1; M=4 | integer value | 1 | 1 |
| 17.010 | **VPS** | **VERTICAL PIXEL SCALE** | M | N; m=1; M=4 | integer value | 1 | 1 |
| 17.011 | **CGA** | **COMPRESSION ALGORITHM** | M | AN; m=3; M=5 | Value from **Table 12** | 1 | 1 |
| 17.012 | **BPX** | **BITS PER PIXEL** | M | N; m=1; M=2 | integer value | 1 | 1 |

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[226] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

[227] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

[228] Clarification of potential ambiguities in earlier versions of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 17.013 | **CSP** | **COLOR SPACE** | M | A; m=3; M=4 | Values from **Table 13** | 1 | 1 |
| 17.014 | **RAE** | **ROTATION ANGLE OF EYE** | O | AN; m=1; M=5 | positive integer value or FFFF | 0 | 1 |
| 17.015 | **RAU** | **ROTATION UNCERTAINTY** | O | AN; m=1; M=5 | positive integer value or FFFF | 0 | 1 |
| 17.016 | **IPC** | **IMAGE PROPERTY CODE** | O | | | 0 | 1 |
| | IHO | horizontal orientation code | M⇑ | N; m=1; M=1 | $0 \leq IHO \leq 2$ integer value | 1 | 1 |
| | IVO | vertical orientation code | M⇑ | N; m=1; M=1 | $0 \leq IVO \leq 2$ integer value | 1 | 1 |
| | IST | scan specific type | M⇑ | N; m=1; M=1 | IST = 0 or 1 | 1 | 1 |
| 17.017 | **DUI** | **DEVICE UNIQUE IDENTIFIER** | O | ANS; m=16; M=16 | first character of 16 = M or P | 0 | 1 |
| 17.018 | | **Deprecated; See ANSI/NIST-ITL 1-2007 for a description of this field** | | | | | |
| 17.019 | **MMS** | **MAKE/MODEL/SERIAL NUMBER** | O | | | 0 | 1 |
| | MAK | make | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| | MOD | model | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| | SER | serial number | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| 17.020 | **ECL** | **EYE COLOR** | O | A; m=3; M=3 | Value from **Table 14** | 0 | 1 |
| 17.021 | **COM** | **COMMENT**[229] | O | ANS; m = 1; M= 126 | None | 0 | 1 |
| 17.022 | **SHPS** | **SCANNED HORIZONTAL PIXEL SCALE** | O | N; m=1; M=4 | positive integer value | 0 | 1 |
| 17.023 | **SVPS** | **SCANNED VERTICAL PIXEL SCALE** | O | N; m=1; M=4 | positive integer value | 0 | 1 |
| 17.024 | **IQS** | **IMAGE QUALITY SCORE** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[230] |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Occurrence count Max |
|---|---|---|---|---|---|---|---|
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or $QVU = 254$ or $255$ integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m=4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 17.025 | **EAS** | **EFFECTIVE ACQUISITION SPECTRUM** | M | | | 1 | 1 |
| | SPV | spectrum value | M | A; m=3; M=9 | value from Table 72 | 1 | 1 |
| | LOW | spectrum lower bound | C-SPV | N; m=3; M=3 | $500 < LOW < 999$ integer value | 0 | 1 |
| | HIG | spectrum upper bound | C-SPV | N; m=3; M=3 | $500 < HIG < 999$ integer value | 0 | 1 |
| 17.026 | **IRD** | **IRIS DIAMETER** | O | N; m=2; M=4 | $10 < IRD < 9999$ integer value | 0 | 1 |
| 17.027-17.029 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 17.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=7; M=10 | Value from **Table 11** | 0 | 1 |
| 17.031 | **SAP**[231] | **SUBJECT ACQUISITION PROFILE** | O | N; m=2; M=2 | SAP = 20, 30 or 40 | 0 | 1 |
| 17.032 | **ISF**[231] | **IRIS STORAGE FORMAT** | M | N; m=1; M=1 | ISF = 1, 2, 3 or 7 | 1 | 1 |
| 17.033 | **IPB**[231] | **IRIS PUPIL BOUNDARY** | O | | | 0 | 1 |
| | IPC | iris pupil code | M⇑ | A; m=1; M=1 | IPC = C, E or P | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $2 \leq NOP \leq 99$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour – for a total of NOP pairs | M⇑ | | | | |
| | HPO | horizontal point offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 2 | NOP |
| | VPO | vertical point offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 2 | NOP |

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[231] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Max |
|---|---|---|---|---|---|---|---|
| 17.034 | **ISB[232]** | **IRIS SCLERA BOUNDARY** | O | | | 0 | 1 |
| | ISC | iris sclera code | M⇑ | A; m=1; M=1 | ISC = C, E or P | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $2 \leq NOP \leq 99$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour – for a total of NOP pairs | M⇑ | | | | |
| | HPO | horizontal point offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 2 | NOP |
| | VPO | vertical point offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 2 | NOP |
| 17.035 | **UEB[232]** | **UPPER EYELID BOUNDARY** | O | | | 0 | 1 |
| | UEC | upper eyelid code | M⇑ | A; m=1; M=1 | UEC = P | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour – for a total of NOP pairs | M⇑ | | | | |
| | HPO | horizontal point offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 3 | NOP |
| | VPO | vertical point offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 3 | NOP |
| 17.036 | **LEB[232]** | **LOWER EYELID BOUNDARY** | O | | | 0 | 1 |
| | LEC | lower eyelid code | M⇑ | A; m=1; M=1 | LEC = P | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour – for a total of NOP pairs | M⇑ | | | | |
| | HPO | horizontal point offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 2 | NOP |

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[232] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | VPO | vertical point offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 2 | NOP |
| 17.037 | **OOC[233]** | **OTHER OCCLUSIONS** | O | | | 0 | Unlimited |
| | IOC | iris occlusion code | M⇑ | A; m=1; M=1 | IOC = T, I, L or S | 1 | 1 |
| | OCT | iris occlusion type | M⇑ | A; m=1; M=1 | OCT = L, S, C, R or O | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=3 | $3 \leq NOP \leq 999$ | 1 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour – for a total of NOP pairs | M⇑ | | | | |
| | HPO | horizontal point offset | M⇑ | N; m=1; M=5 | $1 \leq HPO \leq HLL$ integer value | 2 | NOP |
| | VPO | vertical point offset | M⇑ | N; m=1; M=5 | $1 \leq VPO \leq VLL$ integer value | 2 | NOP |
| 17.038- 17.039 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 17.040 | **RAN[233]** | **RANGE** | O | N; m=1; M=7 | positive integer | 0 | 1 |
| 17.041 | **GAZ[233]** | **FRONTAL GAZE** | O | N; m=1; M=3 | $0 \leq GAZ \leq 90$ | 0 | 1 |
| 17.042- 17.093 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 17.800- 17.900 | **UDF** | **USER-DEFINED FIELDS** | O | User defined | User defined[234] | | |
| 17.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 17.902 | **ANN[233]** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |

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[233] New for this version of the standard.

[234] The 2007 version of the standard restricted this to ASCII characters. That restriction has been removed in this version to allow the user to enter characters from the alternate character encoding set defined in **Field 1.015 Directory of character encoding sets / DCS**, consistent with the 2008 version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[235] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $GMT \leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m=1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m=1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m=1; M=255 | None | 1 | 1 |
| 17.903-17.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 17.995 | **ASC[236]** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | ***Subfields: Repeating sets of information items*** | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 17.996 | **HAS[236]** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |

[235] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".
In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":".
Note that T and Z are fixed characters.

[236] New for this version of the standard.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Occurrence count Max |
|---|---|---|---|---|---|---|---|
| 17.997 | **SOR**[237] | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ Integer value | 0 | 1 |
| 17.998 | **GEO**[237] | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[238] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $UTE \leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |

[237] New for this version of the standard.

[238] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus.
In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 17.999 | **DATA** | **IRIS IMAGE DATA** | M | B; m=1; M=* | None | 1 | 1 |

### 8.17.1  Field 17.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.17.2  Field 17.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-17 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

### 8.17.3   Field 17.003: Eye Label (L/R) / ELR

This mandatory field[239] shall contain an identifier for the eye represented by the image in the record.  An entry of "0" in this field indicates that it is undefined which eye is present in this record.  An entry of "1" in this field indicates that the image in this record is the subject's right eye. An entry of "2" in this field indicates that the image in this record is the subject's left eye.

### 8.17.4   Field 17.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.17.5   Field 17.005: Iris capture date / ICD

This mandatory field shall contain the date that the iris biometric data contained in the record was captured. See **Clause 7.15.3** for details.

### 8.17.6   Field 17.006: Horizontal line length / HLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.7   Field 17.007: Vertical line length / VLL

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.8   Field 17.008: Scale units / SLC

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.9   Field 17.009: Horizontal pixel scale / HPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.10  Field 17.010: Vertical pixel scale / VPS

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.11  Field 17.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted color or grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.2** for a detailed description of this field. The baseline JPEG algorithm (*ISO/IEC 10918*) shall not be used for Type-17 iris images.  It has been shown that both false non-match and false match rates increase due to the presence of tiling artifacts introduced by JPEG's discrete cosine transform.

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[239] In prior versions of this standard, this field was named Feature identifier / FID.

While JPEG was allowed in prior versions of this standard, it shall not be allowed for new images. Implementers may want to support JPEG decoding for handling legacy images.

### 8.17.12  Field 17.012: Bits per pixel / BPX

This field is mandatory.  See **Clause 7.19** for details.

### 8.17.13  Field 17.013: Color space / CSP

This is a mandatory field[240].  See **Clause 7.21** for details. If **Field 17.025: Effective acquisition spectrum / EAS** is set to "NIR" this field shall be set to "GRAY".

### 8.17.14  Field 17.014: Rotation angle of eye / RAE

This optional field shall indicate the in-plane rotation angle of the iris.  Such rotation can be caused by head tilt, camera tilt, and also by the common natural rotation of the eye itself.

The roll angle encoded in this field is defined here in terms of roll of the subject's head. The angle is defined as the angle between a line joining the pupil or iris centers of the left and right eyes, and the horizontal axis of the imaging system.  As shown in **Figure 12**, an angle is positive for counter-clockwise rotation, as seen from the camera, of this line relative to the camera's horizontal axis.

The in-plane eye rotation angle shall be recorded as, roll angle = round (65536 * angle / 360) modulo 65536. The value "FFFF" indicates rotation angle of eye is undefined.

For encoding angular orientation of an eye not directed toward the camera, see **Field 17.041: Frontal gaze / GAZ**.

It may be difficult to estimate rotation using a monocular camera.  In such cases, the rotation uncertainty encoded in **Field 17.015: Rotation uncertainty / RAU** will be appropriately larger.

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[240] New for this version of the standard.
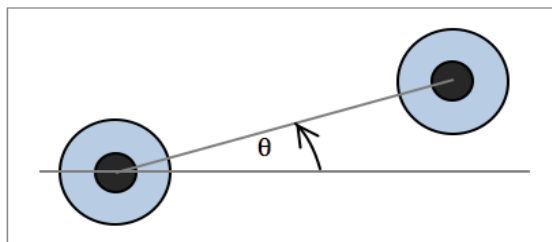
**Figure 12 Coordinate system for eye rotation angle**

### 8.17.15 Field 17.015: Rotation uncertainty / RAU

This optional field shall indicate the uncertainty in the in-plane eye rotation given in Field 17.014: Rotation angle of eye / RAE. This field is mandatory if **Field 17.014: Rotation angle of eye / RAE** is present. The rotation uncertainty is non-negative and equal to [round (65536 * uncertainty / 180)]. The uncertainty is measured in degrees and is the absolute value of maximum error. The value "FFFF" indicates uncertainty is undefined.

### 8.17.16 Field 17.016: Image property code / IPC

This optional field shall contain the image property code. It shall contain three information items.

– The first information item is the **Horizontal orientation code / IHO**. Values for Horizontal Orientation shall be one of: "0" for Undefined, "1" for Base, or "2" for Flipped. "Base" orientation refers to images corresponding to the view facing the subject, where the nasal side of subject's left eye or outer edge of the subject's right eye is on the left side the of image. "Flipped" orientation refers to images where the orientation is opposite from that described for "Base".

– The second information item is the **Vertical orientation code / IVO**. Values for Vertical Orientation shall be one of: "0" for Undefined, "1" for Base, or "2" for Flipped. "Base" orientation refers to images where the superior (top) edge of the eye is at the top of the image. "Flipped" orientation refers to images where the orientation is opposite from that described for "Base".

– The third information item is the **Specific scan type / IST**. Values for Scan Type shall be one of: "0" for Undefined and "1" for Progressive. "Progressive" indicates that the image was captured using progressive scanning, in which case all image lines are generated sequentially.

Prior versions of the standard allowed IST "2" for Interlace Frame, or "3" for Interlace Field. These values shall not be used in records claiming conformance to this version of the standard. Implementers may want to support interlaced imagery for handling legacy images. The deprecated values were defined as follows:

– "Interlace Frame" indicates that the image was captured using interlaced scanning, in which two fields are generated in sequence, the first composed of odd-numbered lines and the second of even-numbered lines.

– "Interlace Field" indicates that the image was captured using interlaced scanning, in which only one field is generated, and then each line is duplicated to produce a full size image.

**8.17.1 Field 17.017: Device unique identifier / DUI**

This is an optional field. See **Clause 7.24.1** for details.

**8.17.2 Field 17.019: Make/Model/Serial Number / MMS**

This is an optional field. See **Clause 7.24.2** for details.

**8.17.3 Field 17.020: Eye color / ECL**

This is an optional field that shall specify the subject's eye color. See **Clause 7.25** and **Table 20** for details on entering values to this field. Estimating eye color labeling is extremely subjective, and of very limited reliability despite its intuitive use in a policing context, for example. Eye color is determined by the amount of melanin pigmentation, and by the spectrum of the incident light. Eye color has not historically been available to or used by recognition algorithms.

**8.17.4 Field 17.021: Comment / COM**

This is an optional field. See **Clause 7.22** for details.

**8.17.5 Field 17.022: Scanned horizontal pixel scale / SHPS**

This is an optional field. See **Clause 7.19** for details.

**8.17.6 Field 17.023: Scanned vertical pixel scale / SVPS**

This is an optional field. See **Clause 7.19** for details.

### 8.17.7 Field 17.024: Image Quality Score / IQS

This optional field shall be used to specify one or more different metrics of image quality score data for the image stored in this record.  Each set of three information items shall be contained in a separate subfield. See **Clause 7.18** for details on the information items.

### 8.17.8 Field 17.025: Effective acquisition spectrum / EAS

This mandatory field indicates the acquisition spectrum used in capturing the iris image. The acquisition spectrum is the effective acquisition spectrum, which is limited by both the lighting spectrum and the spectrum limitations of the acquisition device: it is defined by the overlap of the two spectra.  This field shall have three information items.

The first information item, **Spectrum value/SPV**, contains alphabetic entries selected from the column "Value" in **Table 74.**

The second and third information items are conditional upon the value of **SPV.**[241] These values are mandatory only when SPV = "DEFINED"; otherwise, they are not used.

The second information item is **Spectrum lower bound/LOW**. It is a three digit entry indicating the lower frequency bound in nm.

The third information item is **Spectrum upper bound/HIH**. It is a three digit entry indicating the lower frequency bound in nm.

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[241] New for this version of the standard.

**Table 74 Effective acquisition spectrum codes**

| Value | Description | Spectrum |
|-------|-------------|----------|
| NIR | Near-infrared acquisition | Approx. 700–900[242] nm |
| DEFINED | Defined acquisition spectrum, in range of nanometers rounded to the nearest 10nm, e.g. 0740 to 0760 or 0800 to 0830. This option provides the means to specify the acquisition spectrum when known with precision. When this value is used, two information items shall accompany it.  The format of these two information items shall be a 4-digit integer specifying the minimum of the spectrum range in nanometers, followed by a 4-digit integer specifying the maximum of the spectrum range in nanometers. The minimum value shall be less than or equal to the maximum value. | |
| VIS | Visible full-spectrum acquisition<br>NOTE:  Visible images cannot usually be matched against near-infrared images because either no detail, or different detail, of the iris texture is present in a visible light image.  Interoperability between VIS and NIR images remains a research issue. VIS images are supported by this standard for supplemental, forensic, and research purposes only.  Such use cases may extend to the peri-ocular region. | Approx. 380–750 nm |
| RED | Red portion of visible full-spectrum illumination<br>NOTE: Red light visible images cannot usually be matched against near-infrared images because no detail, noisy detail, or different detail, of the iris texture is present in a red light image.  Interoperability between VIS and RED images remains a research issue.  RED images are supported by this standard for supplemental, forensic, and research purposes only.  Such use cases may extend to the peri-ocular region. | Approx. 620–750 nm |
| UNDEFINED | This value shall be used when the effective spectrum is unknown or unavailable, and is not better described by one of the other values. | |

### 8.17.9    Field 17.026: Iris Diameter / IRD

This optional field shall specify the expected iris diameter in pixels.

### 8.17.10   Field 17.030: Device monitoring mode / DMM

This is an optional field. See **Clause 7.17** for details.

### 8.17.11   Field 17.031: Subject acquisition profile / SAP

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[242] The 2007 and 2008 versions of the standard had a range of 200-850 for NIR; 380 to 740 for VIS. RED was not specified in earlier versions of the standard.

This optional field[243] lists the SAP levels associated with iris acquisition devices. See **Clause 7.13.3** for details.

**8.17.12  Field 17.032: Iris storage format / ISF**
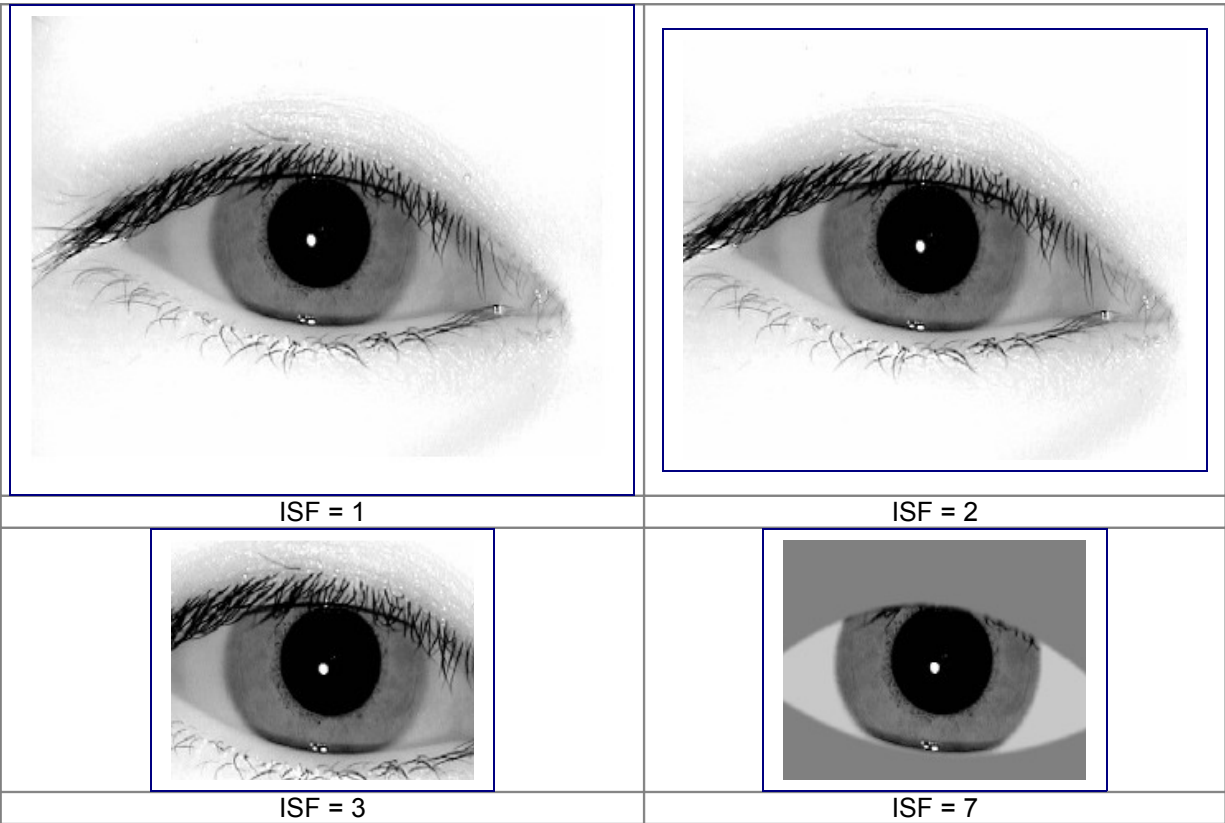


**Figure 13 Examples of ISF image formats**

This mandatory field[244] shall indicate the storage format of the iris image[245]. The codes are shown in **Figure 13** and**Table 75**. The value shall be a single digit corresponding to the column "ISF code".

---

[243] New for this version of the standard.
[244] See Grother et al. "*IREX I, Performance of Iris Recognition Algorithms on Standard Images*", NIST Interagency Report 7629.

[245] New for this version of the standard.

Image storage formats 1 and 2 might be the native output of an iris camera. Image storage formats 3 and 7 are typically prepared by client software: ISF 3 images are cropped; and ISF 7 images are both cropped and masked. These operations, used in conjunction with the standardized compression schemes, afford reduced record sizes.

All of the formats establish geometric specifications. For ISF = 1 and 2, there are minimum margin requirements specified in terms of the estimated iris radius, R (see **Table 75**). For ISF = 3 and 7, there are exact margin requirements. These requirements support accurate localization of the iris boundaries.

**Table 75 Iris storage formats**

| ISF code | Description | Iris Centering | Iris margin requirement | |
|---|---|---|---|---|
| | | | **Horizontal** | **Vertical** |
| 1 | Unconstrained | Recommended | ≥ 0.6R | ≥ 0.2R |
| 2 | Raw: 640x480 | Recommended | ≥ 0.6R | ≥ 0.2R |
| 3 | Cropped | Required | = 0.6R | = 0.2R |
| 7 | Cropped and Masked | Required | = 0.6R | = 0.2R |
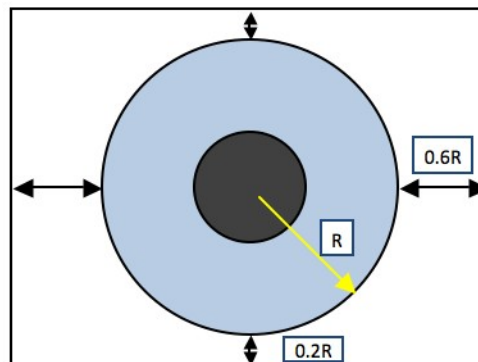


**Figure 14 Iris margin specification**

### 8.17.13  Field 17.033: Iris pupil boundary / IPB

This optional field[246] defines the pupillary boundary, between the iris and pupil. See **Clause 7.23** for a description of encoding paths.

### 8.17.14  Field 17.034: Iris Sclera Boundary / ISB

This optional field[246] defines the limbic boundary, between the iris and sclera. See **Clause**

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[246] New for this version of the standard.

**7.23** for a description of encoding paths.

### 8.17.1   Field 17.035: Upper eyelid boundary / UEB

This optional field[247]  defines the boundary between the upper eyelid and the eye. See **Clause 7.23** for a description of encoding paths.

### 8.17.1   Field 17.036: Lower eyelid boundary / LEB

This optional field[247] defines the boundary between the lower eyelid and the eye. See **Clause 7.23** for a description of encoding paths.

### 8.17.2   Field 17.037: Other Occlusions / OOC

This optional field[247] defines the outline and contents of any non-eyelid occlusions that partially or totally blocks the image of the iris. For details on entering data for this Field, see **Clause 7.23.**  Note that the first information item contains the alphabetic code from **Table 16** and the second information item contains the alphabetic code from **Table 17**.

### 8.17.3   Field 17.040: Range / RAN

This optional field[247] contains the estimated distance from the lens of the camera to the iris. It shall be measured in centimeters.

### 8.17.4   Field 17.041: Frontal gaze / GAZ

This optional field[247] describes the metric that estimates the degree of eye sight-angle relative to the camera.  The angle shall be reported in degrees and defined as that between:

−   The optical axis of the eye, and
−   A line connecting the optical center of the eye and the optical center of the camera.

This measure is inclusive of both head angular orientation and eye-gaze angle relative to the head.  The inclusive approach for gaze direction is not intended to be representative of the possible difficulty with iris segmentation due to non-frontal head orientation. Hence, two images with the same frontal gaze, but significantly different frontal head orientation may perform differently with different segmentation and matching algorithms.

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[247] New for this version of the standard.

### 8.17.1 Fields 17.800-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.17.2 Field 17.902: Annotated Information / ANN

This is an optional field[248], listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Clause 7.5.**

### 8.17.3 Field 17.995: Associated context / ASC

This optional field[248] refers to one or more Record Type-21 with the same can. See **Clause 7.4.**

### 8.17.4 Field 17.996: Hash/ HAS

This optional field[248] shall contain the hash value of the image in **Field 17.999: Iris image / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.17.5 Field 17.997: Source representation / SOR

This optional field[248] refers to a representation in Record Type-20 with the same SRN. See **Clause 7.3.**

### 8.17.6 Field 17.998: Geographic sample acquisition location / GEO

This optional field[248] contains the location where the iris sample was acquired – not where it is stored. See **Clause 7.7**.

### 8.17.7 Field 17.999: Iris image / DATA

This mandatory field contains the iris image. See **Clause 7.8** for details on the Data field entry. In Traditional encoding, this shall be the last physical field in the record.

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[248] New for this version of the standard.

### 8.18 Record Type-18: DNA record

The Type-18 record[249] shall contain and be used to exchange DNA data. This shall be used to exchange Autosomal Short Tandem Repeat (STR), X-Short Tandem Repeat (X-STR) Y-Short Tandem Repeat (Y-STR), Mitochondrial DNA (mtDNA), and electropherogram images of DNA data. This record type is based upon standardized and commonly used DNA analysis and data reporting conventions.

With full consideration to privacy, this standard only uses the non-coding regions of DNA. The regions of the DNA that contain genetic information are deliberately avoided.

The record contains:

- Information about the sending and receiving parties for DNA processing;

- Descriptors of the biological materials and setting (laboratory or mobile unit) used for generation of the DNA data;

- Genotype exchange information; and,

- Information specific to the type of DNA processing that has been performed:
  - Autosomal STR
  - X-STR
  - Y-STR
  - Mitochondrial
  - Pedigree
  - Electropherogram image and data

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[249] New for this version of the standard.

**Table 76 Type-18 record layout**[250]

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 18.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 18.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1; M= 3 | $0 \leq IDC \leq 255$ | 1 | 1 |
| 18.003 | **DLS** | **DNA LABORATORY SETTING** | M | | | 1 | 1 |
| | UTY | unit type | M | N; m=1; M=1 | $1 \leq UTY \leq 4$ integer value | 1 | 1 |
| | LTY | lab type | C-UTY | A; m=1; M=1 | LTY = G, T or O | 0 | 1 |
| | AFG | accreditation flag | C-UTY | N; m=1; M=3 | $0 \leq CFG \leq 6$ or CFG = 255 integer value | 0 | 1 |
| | SOA | scope of accreditation | C-UTY | N; m=1; M=1 | $0 \leq SOC \leq 3$ integer value | 0 | 1 |
| | NOO | name of the organization | O | ANS; m=1; M=100 | None | 0 | 1 |
| | POC | point of contact | O | ANS; m=1; M=200 | None | 0 | 1 |
| | CSC | code of sending country or sub-country | O | ANS; m=2; M=5 | Value from *ISO-3166-2* | 0 | 1 |

[250] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | ION | international organization name | O | ANS; m=1; M=200 | None | 0 | 1 |
| 18.004 | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 18.005 | **NAL** | **NUMBER OF ANALYSES** | M | N; m=1; M=1 | NAL = 0 or 1 | 1 | 1 |
| 18.006 | **SDI** | **SAMPLE DONOR INFORMATION** | M | | | 1 | 1 |
| | DSD | DNA sample donor | M | N; m=1; M=1 | DSD = 0, 1 or 2 | 1 | 1 |
| | GID | gender ID | O | A; m=1; M=1 | GID = M, F or U | 0 | 1 |
| | DLC | date of last contact | O | Dependent upon encoding[251] | $1900 < YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ DLC < current date | 0 | 1 |
| | DOB | date of birth | O | Dependent upon encoding[251] | $1900 < YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ DOB < current date | 0 | 1 |
| | EGP | ethnic group | O | A; m=1; M=50 | None | 0 | 1 |
| | DRA | dental records available | C-DSD | N; m=1; M=1 | RDA = 0, 1 or 2 | 0 | 1 |
| | LLC | sample collection location description | O | ANS; m=1; M=4000 | None | 0 | 1 |
| | SDS | sample donor status | O | N; m=1; M=1 | SDS = 0, 1 or 2 | 0 | 1 |
| 18.007 | **CPR** | **CLAIMED OR PURPORTED RETLATIONSHIP** | C-DSD | N; m=1; M=1 | $1 \leq CPR \leq 7$ | 0 | 1 |
| 18.008 | **VRS** | **VALIDATED RELATIONSHIP** | C-DSD | N; m=1; M=1 | $1 \leq VRS \leq 7$ | 0 | 1 |
| 18.009 | **PED** | **PEDIGREE INFORMATION** | O | | | 0 | 1 |
| | PID | pedigree ID | M⇑ | ANS; m=1; M=24 | None | 1 | 1 |
| | PMI | pedigree member ID | M⇑ | N; m=1; M=6 | None | 1 | 1 |

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[251] In Traditional encoding it is 8 characters: "YYYYMMDD".  In XML it is "YYYY-MM-DD" for a total of 10 characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | PMS | pedigree member status | M⇑ | A; m=1; M=1 | PMS = K or U | 1 | 1 |
| | SID | sample identifier | M⇑ | AN; m=1; M=24 | None | 1 | 1 |
| | FID | father identifier | O⇑ | N; m=1; M=3 | None | 0 | 1 |
| | MID | mother identifier | O⇑ | N; m=1; M=3 | None | 0 | 1 |
| | PCM | pedigree comment | O⇑ | ANS; m=1; M=2000 | None | 0 | 1 |
| 18.010 | **STY** | **SAMPLE TYPE** | M | | | 1 | 1 |
| | SCT | sample cellular type | M⇑ | N; m=1; M=2 | $0 \leq STY \leq 10$ | 1 | 1 |
| | SMO | sample origin | O⇑ | A; m=2; M=2 | SMO = NS, WB or BP | 0 | 1 |
| 18.011 | **STI** | **SAMPLE TYPING INFORMATION** | M | | | 0 | 1 |
| | | *Subfields: Repeating values* | M | N; m=1; M=1 | $0 \leq value \leq 3$ | 1 | 4 |
| 18.012 | **SCM** | **SAMPLE COLLECTION METHOD** | O | ANS; m=1; M=255 | None | 0 | 1 |
| 18.013 | **SCD** | **SAMPLE COLLECTION DATE** | M | Dependent upon encoding[252] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $0 \leq HH \leq 23$ $0 \leq MM \leq 59$ $0 \leq SS \leq 59$ All above are integer values SCD $\leq$ Today's date and time | 1 | 1 |

[252] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".  In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 18.014 | **PSD** | **PROFILE STORAGE DATE** | M | Dependent upon encoding239 | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq HH \leq 23$ $0 \leq MM \leq 59$ $0 \leq SS \leq 59$ All above are integer values PSD $\leq$ Today's date and time | 1 | 1 |
| 18.015 | **DPD** | **DNA PROFILE DATA** | M | | | 1 | 1 |
| | PTP | profile type | M⇑ | N; m=1; M=1 | PTP = 0 or 1 | 1 | 1 |
| | RES | result | M⇑ | N; m=1; M=2 | $0 \leq RES \leq 10$ | 1 | 1 |
| | PRF | profile ID | M⇑ | ANS; m=1; M=64 | None | 1 | 1 |
| | SUP | supplemental message | O⇑ | ANS; m=1; M=32 | None | 0 | 1 |
| | DPC | DNA profile comment | O⇑ | ANS; m=1; M=32 | None | 0 | 1 |
| 18.016 | **STR** | **AUTOSOMAL STR, X-STR and Y-STR PROFILE** | C-STI | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | DST | DNA STR type | M⇑ | N; m=1; M=1 | DST = 0, 1 or 2 | 1 | 1 |
| | DLR | DNA locus reference | M⇑ | AN; m=1; M=3 | $1 \leq DLS \leq 200$ integer value | 1 | 1 |
| | ALL | allele indicator | M⇑ | N; m=1; M=1 | ALL = 0 or 1 | 1 | 1 |
| | LAI | locus analysis indicator | M⇑ | N; m=1; M=1 | LAI = 0 or 1 | 1 | 1 |
| | PCD | precise call determination | M⇑ | N; m=1; M=1 | PCD = 0 or 1 | 1 | 1 |
| | AL1 | allele call 1 | C-ALL | NS; m=5, M=5 | integer > 0; or real number with one digit to right of decimal | 0 | 1 |
| | AL2 | allele call 2 | C-AL1 | NS; m=5, M=5 | integer > 0; or real number with one digit to right of decimal | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | AL3 | allele call 3 | C-ALL | NS; m=5, M=5 | integer > 0; or real number with one digit to right of decimal | 0 | 1 |
| | BID | batch ID | O⇑ | AN; m=1; M=32 | None | 0 | 1 |
| | KID | kit ID | M⇑ | ANS; m=3; M=32 | None | 1 | 1 |
| | KNM | kit name | O⇑ | ANS; m=3; M=32 | None | 0 | 1 |
| | KMF | manufacturer | O⇑ | ANS; m=1; M=32 | None | 0 | 1 |
| | KDS | description of the kit (with part or catalog number) | O⇑ | ANS; m=1; M=128 | None | 0 | 1 |
| 18.017 | **DMD** | **MITOCHONDRIAL DNA DATA** | C-STI | | | 0 | 1 |
| | MT1 | mito control region 1 | M⇑ | A; m=646; M=646 | Value from Table 80 or 81 | 1 | 1 |
| | MT2 | mito control region 2 | M⇑ | A; m=576; M=576 | Value from Table 80 or 81 | 1 | 1 |
| | BSP | base composition starting point | M⇑ | N; m=1; M=5 | positive integer | 1 | 1 |
| | BEP | base composition ending point | M⇑ | N; m=1; M=5 | positive integer | 1 | 1 |
| | BCA | base composition A length | M⇑ | N; m=1; M=2 | positive integer | 1 | 1 |
| | BCG | base composition G length | M⇑ | N; m=1; M=2 | positive integer | 1 | 1 |
| | BCT | base composition T length | M⇑ | N; m=1; M=2 | positive integer | 1 | 1 |
| | BCC | base composition C length | M⇑ | N; m=1; M=2 | positive integer | 1 | 1 |
| 18.018 | **UDP** | **USER DEFINED PROFILE** | C-STI | User defined | User defined | | |
| 18.019 | **EPD** | **ELECTROPHEROGRAM DESCRIPTION** | C-STI | | | 0 | 1 |
| | EIR | electropherogram image reference | M⇑ | AN; m=1; M=8 | None | 1 | 1 |
| | EST | electropherogram storage type | M⇑ | AN; m=1; M=4 | None | 1 | 1 |
| | IDD | image data descriptor | M⇑ | ANS; m=1; M=200 | None | 1 | 1 |
| | EPD | electropherogram data | M⇑ | Base 64; m=2; M=* | Base 64 valid values | 1 | 1 |
| 18.020 | **DGD** | **DNA GENOTYPE DISTRIBUTION** | C-GAP | N; m=1; M=1 | DGD = 0 or 1 | 0 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 18.021 | **GAP** | **DNA GENOTYPE ALLELE PAIR** | C-DGD | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | DGD | genotype locus reference | M⇑ | ANS; m=3; M=20 | $1 \leq DGD \leq 200$ integer value | 1 | 1 |
| | ALP | allele pair | M⇑ | NS; m=3; M=20 | digits, one comma and up to 2 periods allowed | 1 | 1 |
| | GNW | genotype numerical weight | M⇑ | N; m=3; M=5 | $0 < GNW < 1$ | 1 | 1 |
| 18.022-18.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 18.995 | **ASC** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 18.996 | **HAS** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 18.997 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Occurrence count Max |
|---|---|---|---|---|---|---|---|
| 18.998 | **GEO** | GEOGRAPHIC SAMPLE ACQUISITION LOCATION | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[253] | $1900 \leq$ YYYY $1 \leq$ MM $\leq 12$; $1 \leq$ DD $\leq 31$ $0 \leq$ hh $\leq 23$ $0 \leq$ mm $\leq 59$ $0 \leq$ ss $\leq 59$ All above are integer values UTE $\leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \leq$ LTD $\leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq$ LTM $\leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq$ LTS $\leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq$ LGD $\leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq$ LGM $\leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq$ LGS $\leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 <$ ELE $<$ 8848.000 real number | 0 | 1 |

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[253] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm".  The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 18.999 | **DATA** | **ELECTROPHEROGRAM IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

### 8.18.1 Field 18.001: Record Header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.18.2 Field 18.002: Information designation character / IDC

This mandatory field shall be the IDC of this Type-18 record as found in **Field 1.003 Transaction content / CNT**. See **Clause 7.2.**

### 8.18.3 Field 18.003: DNA laboratory setting / DLS

This field is mandatory. The first information item is mandatory. The remaining information items are optional for all unit types.

The first information item **Unit type / UTY** is mandatory and contains a numeric value is selected from the following table:

**Table 77 DNA laboratory setting (DLS)**

| Value | Description |
|---|---|
| 1 | Laboratory DNA processing unit |
| 2 | Rapid DNA / mobile processing unit |
| 3 | Other |
| 4 | Unknown |

The second information item is the **Lab Type / LTY**.  It is mandatory if the value for UTY is 1 or 2.  It is not entered otherwise.  When present, this information item contains a single character describing the laboratory that processed the DNA:

> G = Government
> I = Industry
> O = Other laboratory

The third information item is the **Accreditation Flag / AFG**. It is mandatory if the value for UTY is 1 or 2.  It shall not be entered otherwise.  When present, this information item shall contain a single numeric value describing the laboratory that processed the DNA. More than one certification flag is permitted[254]. Allowable values are:

- o   0 = No Accreditation

- o   1 = ISO Accreditation

- o   2 = GLP Accreditation

- o   3 = AABB Accreditation

- o   4 = ISO/ILAC Guide 19 Accreditation

- o   5 = ASCLD Lab Accreditation

- o   6 = Other

- o   255 = Unknown

- The fourth information item is the **Scope of Accreditation / SOA**.  It is a mandatory field if the value for UTY is 1 or 2.  When present, this information items shall contain a single numeric value describing the certification scope of the laboratory that processed the DNA.  More than one scope of certification is permitted[255].

  - o   0 = Nuclear

  - o   1 = Mitochondrial

  - o   2 = Database

  - o   3 = Other

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[254] The values are separated by commas if there are multiple accreditations.

[255] The values are separated by commas if there are multiple scopes of certification.

- The fifth information item is the **Name of the organization / NOO** that originally processed the DNA data (This may be different from the entry in **Field 18.004: Originating agency / ORG**). This is an optional information item that may be up to 100 alphanumeric characters in length.

- The sixth information item is the **Point of Contact / POC** who composed the DNA record metadata. This is an optional information item that could include the name, telephone number and e-mail address of the person responsible for this record submission. This information item may be up to 200 alphanumeric characters in length.

- The seventh information item is the *ISO-3166-2* **Code of the sending country or sub-country / CSC**. This is the code of where the DNA was processed -- not necessarily the nation of the ORI / SRC. This is an optional information item.

- The eighth information item is the **International Organization Name / ION** of the submitting organization. This is completed if record is not affiliated specifically with a country listed in the seventh information item. This optional information item is the name/acronym of organizations, and may be up to 100 alphanumeric characters.

### 8.18.1    Field 18.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.18.2    Field 18.005: Number of Analyses / NAL

This mandatory field indicates whether the DNA record contains multiple or single data analyses. Possible entries are:

- o    0 = "Multiple" or
- o    1 = "Single"

### 8.18.1    Field 18.006: Sample donor information/ SDI

This field is mandatory. It indicates if the DNA information is from the subject described in Record Type-2 or if it is from another person. Note that multiple Type-18 records may be included in a single transaction; only one record may have a value of 0.

- The allowed numeric values for the first mandatory information item **DNA sample donor / DSD** are:

- o    0 = Subject of the transaction
- o    1 = Claimed, purported or validated relative
- o    2 = Unknown source

- The second information item is the **Gender ID / GID**. This is an optional

single character identifier of "M" or 'F' or "U". U indicates unknown.

- The third information item, **Date of Last Contact / DLC**, is an optional date field. See **Clause 7.15.3** for the format.

- The fourth information item, **Date of Birth / DOB**, is an optional date field. **Clause 7.15.3** for the format.

- The fifth information item is the **Ethnic Group / EGP**. It is an optional string of 50 characters used for which the sample belongs.

- The sixth information item is optional and indicates if dental records are available for the subject (**Dental Records Available / DRA**). This information item shall be entered only if DSD=0. Allowed numeric values are:
  - 0 = No
  - 1 = Yes
  - 2 = Unknown

- The seventh optional information item is the sample collection **Location Description / LLC**. It is an optional string of up to 4000 characters.

- The eighth optional information item is the **Sample Donor Status / SDS**. This information item will include whether or not the sample donor is deceased, missing or unknown. Allowed numeric values are:
  - 0 = Deceased
  - 1 = Missing Person
  - 2 = Unknown

### 8.18.1   Field 18.007: Claimed or Purported Relationship / CPR

This field is mandatory if the value for DSD is equal to 1. It is selected from **Table 78**. It is a numeric value selected from the "Relationship code" column.

**Table 78 Relationship Table**

| Relationship code | Relationship Description |
|---|---|
| 1 | Biological child |
| 2 | Biological father |
| 3 | Biological mother |
| 4 | Biological sibling |
| 5 | Maternal relative |
| 6 | Paternal relative |
| 7 | Other / unknown |

**8.18.2    Field 18.008: Validated Relationship / VRS**

This field is optional and is a numeric value selected from the "Relationship Code" column of **Table 78.** This information item is completed based upon a comparison of the subject's DNA with the DNA of the person with whom the relationship is claimed or purported. It is only filled in if DSD = 1.

**8.18.3    Field 18.009 Pedigree Information / PED**

This optional field contains information and structure associated with the pedigree.

- The first information item is the **Pedigree ID / PID**. It is a character string of up to 24 characters. It is mandatory if this field is used and it indicates the identity of the pedigree determined and held at the laboratory that originates the pedigree.

- The second information item is the **Pedigree Member ID / PMI**. It is a unique number within the pedigree.  It is mandatory if this field is used.  This information item refers to the subject of the transaction. It is an alphanumeric of up to 6 characters.  This information item shall also provide the ability to link pedigree information.

- The third information item is the **Pedigree Member Status / PMS**. It is mandatory if this field is used and is a character string containing one of the following values: [This information item refers to DNA associated with this record]

  - K = Known

  - U = Unknown

- The fourth information item is the DNA **Sample Identifier / SID** for the transaction.  It is not an identifier within the pedigree chain, unlike the following

two identifiers or the PID. It is a character string of 24 characters or less. This information item relates the sample in this record to the pedigree.

- The fifth information item is the **Father Identifier / FID**. It is optional and is a numeric value of 3 digits or less. This information item is the father identified as related to the sample indicated in the PMI item.

- The sixth information item is the **Mother Identifier / MID**. It is optional and is a numeric value of 3 digits or less. This information item is the mother identified as related to the sample indicated in the PMI item.

- The seventh optional information item is the **Pedigree Comment / PCM**. It is alphanumeric (up to 2000 characters).

**8.18.1    Field 18.010: Sample Type / STY**

This mandatory field contains two information items.

The first represents the origination cell type from where the sample was collected (**Sample Cellular Type / SCT**). It is mandatory and shall contain a numeric value selected from the "Cellular code' column of **Table 79.**

**Table 79 DNA Sample Cellular Types**

| Cellular code | Cellular type |
|:---:|:---|
| 0 | Blood |
| 1 | Bone |
| 2 | Co-mingled Biological Material |
| 3 | Hair |
| 4 | Saliva |
| 5 | Semen |
| 6 | Skin |
| 7 | Sweat or Fingerprint |
| 8 | Tissue |
| 9 | Other |
| 10 | Unknown |

The second information item is the **Sample Origin/ SMO**. It is an optional item of a string of 2 characters describing where the sample was obtained containing one of the following values:

NS = Not Specified.
WB = Whole Body.
BP = Body Part.

### 8.18.2　Field 18.011: Sample typing Information / STI

This mandatory field represents the technology utilized to type the DNA sample. A repeating subfield with the following information item shall comprise this field. The subfield shall contain a number from the following list:

- o 0= Nuclear (indicates presence of )
- o 1 = mtDNA (indicates presence of **Field 18.017: Mitochondrial DNA Data / DMD**)
- o 2 = electropherogram data (indicates presence of **Field 18.019: Electropherogram Description / EPD**)
- o 3 = Other (indicates presence of **Field 18.018: DNA User Defined Profile / UDP**)

### 8.18.1　Field 18.012: Sample collection method / SCM

This field contains a description of the method used to collect the DNA sample. It is a character string up to 255 characters.

### 8.18.2　Field 18.013: Sample collection date / SCD

This mandatory field contains the date and time that the sample was collected. See **Clause 7.15.2 Coordinated universal time** for details.

### 8.18.3　Field 18.014: Profile storage date / PSD

This mandatory field contains the date and time that the sample was collected. See **Clause 7.15.2 Coordinated universal time** for details.

### 8.18.4 Field 18.015: DNA Profile Data / DPD

This is a mandatory field.  It contains information and structure associated with the DNA profile data.  It is comprised of the following information items:

- The first information item is mandatory.  It is the **Profile Type / PTP**. It is a numerical value. Allowable values are 0 = Person or 1 = Stain.

- The second information item is mandatory and is the **Result / RES**. It is entered with a numeric value selected from **Table 80**.

- The third information item is mandatory and is the **Profile ID / PRF**. It is a character string with a unique party identification. This information item is used to uniquely identify the profile or sample for which the transaction is based. It is a maximum of 64 alphanumeric characters.

- The optional fourth information item is a **Supplemental Message / SUP**. This information item states if this transaction is a supplemental message to a previous transmission. It is an alphanumeric string containing up to 32 characters.

- The optional fifth information item is **a DNA Profile Comment / DPC**. It is an alphanumeric string containing up to 32 characters.

**Table 80 DNA result codes**

| Code | Description |
|:----:|:-----------:|
| 0 | Unable to process |
| 1 | No hit |
| 2 | Hit |
| 3 | Hit, high/exact |
| 4 | Hit, moderate |
| 5 | Hit, low |
| 6 | Additional Results/Details |
| 7 | User defined 2 |
| 8 | User defined 3 |
| 9 | User defined 4 |
| 10 | User defined 5 |

### 8.18.1    Field 18.016: Autosomal STR, X-STR, and Y-STR Profile / STR

This optional field may be comprised of as many subfields as there are combinations of data type and locus type reported.

- The first information item is mandatory. It is the **DNA STR Type / DST**. It has one of the following numeric values:
  - 0= Autosomal STR Profile
  - 1= X-STR Profile
  - 2= Y-STR Profile

- The second information item is mandatory. It is the **DNA locus reference / DLR**. The current valid loci for Autosomal, Y and X-STRs are maintained by NIST and are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. This information item is a numeric entry with up to 3 characters per locus.

- The third information item is mandatory. It is the **Allele indicator / ALL**. It is a numeric entry containing a zero if no allele is found. Otherwise it is filled with a 1.

- The fourth information item is mandatory. It is the **Locus analysis indicator / LAI**. It is a numeric entry, containing a zero if not analyzed. Otherwise it contains a 1.

- The fifth information item is mandatory. It is the **Precise call determination / PCD**. It is a numeric entry containing a zero if the precise call cannot be determined, due to an uncertainty in the call. Otherwise it contains a 1.

- The sixth information item is conditional upon the value of ALL being 1. It is the **Allele Call 1 / AL1**. This is the allele call for the locus reference DLR. It contains up to 4 character, such as "11" or "23.3"

- The seventh information item is conditional upon the value of ALL being 1. It is the **Allele Call 2 / AL2**. This is the allele call for the locus reference DLR. It contains up to 4 character, such as "11" or "23.3" It shall appear if AL1 is used.

- The eighth information item is optional but shall not appear unless ALL = 1. It is the **Allele Call 3 / AL3**. This is the allele call for the locus reference DLR. It contains up to 4 character, such as "11" or "23.3". This is not used for mixtures, but is for the rare case of a tri-allele.

- The ninth information item is the **Batch ID / BID**. This optional information item shall contain an identifier for the batch to which a locus belongs. This may be referred to as the gel or place identifier. A specimen may have loci from multiple batches. The Batch Id shall be an alphanumeric string up to 32 characters.

- The tenth information item is the **Kit ID / KID**. This mandatory information item contains information describing the kit used to process the DNA. It is comprised of three mandatory information items. The values for these entries are contained in the list of kits maintained by NIST and is available at : http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. This field's data shall describe a Kit aligned with the DNA Profile data in this record. If the KID for a non-listed kit is chosen, then the eleventh, twelfth and thirteenth information items are mandatory.

- The eleventh information item is the **Kit Name / KNM**. This is an alphanumeric value of up to 32 characters.

- The twelfth information item is the **Manufacturer / KMF**. This is an alphanumeric value of up to 32 characters.

- The thirteenth information item is the **Description of the Kit (with part or catalog number) / KDS**. This is an alphanumeric value of up to 128 characters.

### 8.18.1   Field 18.017: Mitochondrial DNA Data / DMD

To accommodate the differences in how mtDNA types are derived (differences from reference), the interpretation issue is avoided in this standard by dividing the control region into 2 regions (even though HV3 exists) to ensure any insertions / deletions/ C-stretches are included.  This method enables any receiver of the data to use it in a way to which they are accustomed (either using the full sequence or interpreting the full sequence according to their own methodology).  The resultant data use would then be fully consistent with the receiver's database and enable processing. This is an optional field, but if it is entered, all information items are mandatory.

- The first information item is the **Mito Control Region 1 / MT1**. It is defined as inclusive of HV1, starting at 16024 and ending at 16569.  The string shall be 646 characters.  This string length allows for insertions.  Each character is an IUPAC value from **Table 81** or a sequence value: A, G, C or T.

- The second information item is the **Mito Control Region 2 / MT2** is defined as inclusive of HV2 and HV3, starting at 1 and ending at 576. Each character is an IUPAC value the following two tables.

**Table 81 IUPAC DNA codes**

| IUPAC Code | Definition |
|:---:|:---:|
| R | G, A |
| Y | T, C |
| M | A, C |
| K | G, T |
| S | G, C |
| W | A, T |
| H | A, C, T |
| B | G, T, C |
| V | G, C, A |
| D | G, A, T |
| N | G, A, T, C |
| - | Deletion |

- The third information item is the **base composition starting point / BSP**. This entry is numeric, up to 5 digits.

- The fourth information item is the **base composition ending point / BEP**. This entry is numeric, up to 5 digits.

- The fifth information item is the **base composition A length / BCA**. It is a numerical value of two digits.

- The sixth information item is the **base composition G length / BCG**. It is a numerical value of two digits.

- The seventh information item is the **base composition C length / BCC**. It is a numerical value of two digits.

- The eighth information item is the **base composition T length / BCT**. It is a numerical value of two digits.

When interrogating mtDNA, depending on primers and sequencing, the ordering of content is impacted (i.e. one obtains the A, G, C, and T content rather than the order of A, G, C, and T).

| Starting point | Stopping Point | A | G | C | T |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

Starting point –the base position (rCRS) where the primer pair starts interrogating the mitochondrial DNA.

Stopping point –the base position (rCRS) where the primer pair stops interrogating the mitochondrial DNA.

A –the number of adenines the region being amplified.

G –the number of guanines in the region being amplified.

C –the number of cytosines in the region being amplified.

T –the number of thymines in the region being amplified.

### 8.18.1 Field 18.018: DNA User Defined Profile / UDP

This optional field is user defined, when data other than Autosomal STR, X-STR, Y-STR, mtDNA, or an Electropherogram is included as part of the transaction. The sender shall provide the receiver with a description of the field contents.

### 8.18.2 Field 18.019: Electropherogram Description / EPD

This optional field contains a subfield for each electropherogram. Each subfield is comprised of the following information items, which are mandatory if this field is used:

- The first information item is the **Electropherogram image reference / EIR**. It shall contain an alphanumeric reference up to 8 characters, which is unique for each image. If none has been assigned, enter 999.

- The second information item is the **Electropherogram storage type / EST**. This is a character string of up to 4 characters, representing the file type suffix for the electropherogram. The data is stored in "fsa", "hid" or "----" The dashes may be substituted with character strings for other format types as they become available.

- The third information item is the **Image Data Descriptor / IDD** of the electropherogram contained in this subfield. If the data is stored externally, enter the filename. This is an alphanumeric string with special characters allowed.

- The fourth information item is the **Electropherogram data/ EPD**. This shall be stored in Base 64 format.

### 8.18.1 Field 18.020: DNA Genotype Distribution / DGD

This field contains informative Genotype representation type of DNA information. This field shall be present if **Field 18.021: DNA Genotype Allele Pair / GAP** is present; otherwise it is not present. The entry is numeric, with one of the following entries:

- o   0 = Likelihood

- o   1 = Probability

### 8.18.1 Field 18.021: DNA Genotype Allele Pair / GAP

This field is only present if **Field 18.020: DNA Genotype Distribution / DGD** has a value. It is used for low-template, mixture or stain scenarios only. It is comprised of a repeating subfield that occurs once for each allele pair. Allele calls are captured in the Autosomal STR, X-STR, and Y-STR Profile / STR portion of the record. The field that contains the following information items:

- The first information item is the **Genotype locus reference / GLR**. The current valid loci for Autosomal, Y and X-STRs are maintained by NIST and are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. The GLR is a numeric entry with up to 3 characters per locus.

- The second information item is the **Allele Pair / ALP**. This is a numeric information item containing the allele pair data of up to 9 alphanumeric characters separated by a comma between values. An example is "14,23.3" or "22.1,23.3"

- The third information item is the **Genotype numerical weight / GNW**. It is a non-negative real number up to 5 characters. An example is "0.114".

### 8.18.1  Field 18.995: Associated context / ASC

This optional field refers to one or more Record(s) Type-21. See **Clause 7.4.**

### 8.18.2  Field 18.996: Hash/ HAS

This optional field shall contain the hash value of **Field 18.999: Electropherogram image / DATA**, if present. See **Clause 7.6**.

### 8.18.3  Field 18.998: Geographic sample location / GEO

This optional field contains the location where the DNA was acquired – not where it is stored. See **Clause 7.7**.

### 8.18.4  Field 18.999: Electropherogram image / DATA

This optional field contains the electropherogram image. This may be from a screenshot, saved in a file for transmission purposes. See **Clause 7.8** for details on the Data field entry.

## 8.19   Record Type-19: Plantar image record

The Type-19 record[256] shall contain and be used to exchange plantar print image data together with fixed and user-defined textual information fields pertinent to the digitized image.  Information regarding the scanning resolution used, the image size, and other parameters or comments required to process the image are recorded as fields within the record.

Plantar print images transmitted to other agencies will be processed by the recipient agencies to extract the desired feature information required for matching purposes. Plantars are defined in this standard to be friction ridge prints from the foot.  The areas are the five individual toes, ball/inter-digital area, arch and heel for each foot.  A record card for printing the plantar images is called the Plantar Print Record (PPR), with four cards per record: one flat and one rolled impression for each foot.  It is recommended to capture foot friction ridge data at 1000 ppi.

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[256] New for this version of the standard.

**Table 82 Type-19 record layout**[257]

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 19.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 19.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 < IDC < 255$ | 1 | 1 |
| 19.003 | **IMP** | **IMPRESSION TYPE** | M | N; m=1;M=2 | IMP = 30 or 31 | 1 | 1 |
| 19.004 | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 19.005 | **PCD** | **PLANTAR CAPTURE DATE** | M | Dependent upon encoding[258] | $1900 \leq YYYY$ $1 \leq MM \leq 12$ $1 \leq DD \leq 31$ All above are integer values $PHD \leq$ Today's date | 1 | 1 |

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[257] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[258] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 19.006 | HLL | HORIZONTAL LINE LENGTH | M | N; m=3; M=4 | 1 ≤ HLL ≤ 99999 integer value | 1 | 1 |
| 19.007 | VLL | VERTICAL LINE LENGTH | M | N; m=3; M=4 | 1 ≤ VLL ≤ 99999 integer value | 1 | 1 |
| 19.008 | SLC | SCALE UNITS | M | N; m=1; M=1 | 0 ≤ SLC ≤ 2 integer value | 1 | 1 |
| 19.009 | HPS | HORIZONTAL PIXEL SCALE | M | N; m=1; M=4 | integer value | 1 | 1 |
| 19.010 | VPS | VERTICAL PIXAL SCALE | M | N; m-1; M=4 | integer value | 1 | 1 |
| 19.011 | CGA | COMPRESSION ALGORITHM | M | AN; m=3; M=5 | Value from **Table 12** | 1 | 1 |
| 19.012 | BPX | BITS PER PIXEL | M | N; m=1; M=2 | Integer value | 1 | 1 |
| 19.013 | FGP | FRICTION RIDGE (PLANTAR) GENERALIZED POSITION | M | N; m=2; M=2 | 60 ≤ FGP ≤ 77 | 1 | 1 |
| 19.014-19.015 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 19.016 | SHPS | SCANNED HORIZONTAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 19.017 | SVPS | SCANNED VERTICAL PIXEL SCALE | O | N; m=1; M=4 | integer value | 0 | 1 |
| 19.018 | FSP | FRICTION RIDGE – PLANTAR SEGMENT POSITION | O | | | | |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 4 |
| | FGP | friction ridge generalized position | M⇑ | N; m=1; M=2 | 64 ≤ FGP ≤ 73 | 1 | 1 |
| | NOP | number of points | M⇑ | N; m=1; M=2 | 3 ≤ NOP ≤ 99 | 1 | 1 |
| | HPO | horizontal (x) pixel offset | M⇑ | N; m=1; M=4 | 1 ≤ HPO ≤ HLL | 1 | 1 |
| | VPO | vertical (y) pixel offset | M⇑ | N; m=1; M=4 | 1 ≤ VPO ≤ VLL | 1 | 1 |
| 19.019 | RSV | RESERVED FOR FUTURE USE | | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count Min | Max |
|---|---|---|---|---|---|---|---|
| 19.020 | **COM** | **COMMENT** | O | ANS; m=1; M=126 | None | 0 | 1 |
| 19.021-19.023 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 19.024 | **FQM** | **FRICTION RIDGE - PLANTAR PRINT QUALITY METRIC** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9 |
| | FRC | friction ridge code | M⇑ | N; m=1; M=2 | $60 \leq FRC \leq 77$ | 1 | 1 |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or $QVU = 254$ or $255$ integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 19.025-19.029 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 19.030 | **DMM** | **DEVICE MONITORING MODE** | O | A; m=8; M=10 | Values from **Table 11** | 1 | 1 |
| 19.031-19.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 19.200 – 19.900 | **UDF** | **USER DEFINED FIELDS** | O | User defined | User defined | | |
| 19.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 19.902 | **ANN** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[259] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values GMT $\leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 19.903-19.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 19.995 | **ASC** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |

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[259] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ". In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | 1 ≤ ASP ≤ 99 integer value | 0 | 1 |
| 19.996 | **HAS** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 19.997 | **SOR** | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | 1 ≤ SRN ≤ 255 integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | 1 ≤ RTV ≤ 99 integer value | 0 | 1 |
| 19.998 | **GEO** | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[260] | 1900 ≤ YYYY 1 ≤ MM ≤12; 1 ≤ DD ≤31 0 ≤ hh ≤23 0 ≤ mm ≤59 0 ≤ ss ≤59 All above are integer values UTE ≤ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | -90 ≤ LTD ≤ 90 | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | 0 ≤ LTM ≤ 60 | 0 | 1 |

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[260] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 19.999 | **DATA** | **PLANTAR IMAGE** | M | B; m=1; M=* | None | 1 | 1 |

### 8.19.1   Field 19.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.19.2   Field 19.002: Image designation character / IDC

This mandatory field shall be the IDC of this Type-19 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2.**

### 8.19.3 Field 19.003: Impression type / IMP

This mandatory field shall indicate the manner by which the plantar print was obtained. See **Clause 7.9** for details.

### 8.19.4 Field 19.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.19.5 Field 19.005: Plantar capture date / PCD

This mandatory field shall contain the date that the plantar biometric data contained in the record was captured. See **Clause 7.15.3** for details.

### 8.19.6 Field 19.006: Horizontal line length / HLL

This field is mandatory. See **Clause 7.19** for details.

### 8.19.7 Field 19.007: Vertical line length / VLL

This field is mandatory. See **Clause 7.19** for details.

### 8.19.8 Field 19.008: Scale units / SLC

This field is mandatory. See **Clause 7.19** for details.

### 8.19.9 Field 19.009: Horizontal pixel scale / HPS

This field is mandatory. See **Clause 7.19** for details.

### 8.19.10 Field 19.010: Vertical pixel scale / VPS

This field is mandatory. See **Clause 7.19** for details.

### 8.19.11 Field 19.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 12** for a list of the codes, and **Clause 7.20.1** for a detailed description of this field.

### 8.19.12 Field 19.012: Bits per pixel / BPX

This field is mandatory. See **Clause 7.19** for details.

### 8.19.13 Field 19.013: Friction ridge (Plantar) generalized position / FGP

This mandatory field shall contain the plantar print position that matches the plantar print image. Valid codes range from 60 to 77. See **Table 4**. See **Clause 7.10** for details.

### 8.19.14 Field 19.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Clause 7.19** for details.

### 8.19.15 Field 19.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Clause 7.19** for details.

### 8.19.16 Field 19.018: Friction ridge - plantar segment position(s) / FSP

This is an optional field. It is provides for describing the locations for each of the image segments of up to five individual toes within a flat image containing the capture the entire plantar image. This field shall consist of up five repeating subfield, one for each segment. See **Clause 7.23** for details. There need not be more than one subfield present.

### 8.19.17 Field 19.020: Comment / COM

This is an optional field. See **Clause 7.22** for details.

### 8.19.18 Field 19.024: Friction ridge - Plantar print quality metric / FQM

This optional field is used to specify one or more different metrics of plantar print image quality score data for the image stored in this record. Each subfield is comprised of four information items. The first information shall be the **friction ridge code / FRC** for the image stored in this record. Valid codes range from 60 to 77. See **Table 4.** See **Clause 7.18** for a description of the remaining three information items.

### 8.19.19 Field 19.030: Device monitoring mode / DMM

This is an optional field. See **Clause 7.17** for details.

### 8.19.20 Fields 19.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.19.21  Field 19.902: Annotated Information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type.  See **Clause 7.5.**

### 8.19.22  Field 19.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same ACN. See **Clause 7.4** for details**.**

### 8.19.23  Field 19.996: Hash/ HAS

This optional field shall contain the hash value of the image in **Field 19.999: Plantar image / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.19.24  Field 19.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same SRN.

### 8.19.25  Field 19.998: Geographic sample acquisition location / GEO

This optional field contains the location where the plantar sample was acquired – not where it is stored.  See **Clause 7.7**.

### 8.19.26  Field 19.999: Plantar image / DATA

This mandatory field contains the plantar image. See **Clause 7.8** for details on the Data field entry.  In Traditional encoding, this shall be the last physical field in the record.

## 8.20 Record Type-20: Source representation record

The Type-20 record[261] contains source representations employed to create representation used in another record This record type need not be included in a transaction.

**Table 83 Type-20 record layout[262]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 20.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 20.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$ | 1 | 1 |
| 20.003 | **SDE** | **SRN DESCRIPTION** | M | A; m=1; M=1 | SDE = S, D, or M | 1 | 1 |
| 20.004 | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |

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[261] New for this version of the standard.

[262] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 20.005 | **SRD** | **SOURCE REPRESENTATION DATE** | M | Dependent upon encoding[263] | $1900 < YYYY$ $1 \leq MM \leq 12$ $1 < DD < 31$ $0 < hh < 59$ $0 < mm < 59$ integer values SRD < current date and time | 1 | 1 |
| 20.006 | **HLL** | **HORIZONTAL LINE LENGTH** | M; C-2D image | N; m=3; M=5 | $1 \leq HLL \leq 99999$ integer value | 1 | 1 |
| 20.007 | **VLL** | **VERTICAL LINE LENGTH** | M; C-2D image | N; m=3; M=5 | $1 \leq VLL \leq 99999$ integer value | 1 | 1 |
| 20.008 | **SLC** | **SCALE UNITS** | M; C-2D image | N; m=1; M=1 | SLC = 0, 1 or 2 | 1 | 1 |
| 20.009 | **HPS** | **HORIZONTAL PIXEL SCALE** | M; C-2D image | N; m=1; M=4 | positive integer value | 1 | 1 |
| 20.010 | **VPS** | **VERTICAL PIXAL SCALE** | M; C-2D image | N; m-1; M=4 | positive integer value | 1 | 1 |
| 20.011 | **CGA** | **COMPRESSION ALGORITHM** | M; C-2D image | A; m=3; M=5 | value from **Table 12** | 1 | 1 |
| 20.012 | **BPX** | **BITS PER PIXEL** | C-2D image | A; m=1; M=2 | positive integer | 1 | 1 |
| 20.013 | **CSP** | **COLOR SPACE** | M; C-2D image | A; m=3; M=4 | Value from **Table 13** | 1 | 1 |
| 20.014 | **AQS** | **ACQUISITION SOURCE** | M | | | 1 | 1 |
| | AQT | acquisition source type | M | N; m=1; M=2 | Value from **Table 86** | 1 | 1 |

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[263] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | A2D | analog to digital conversion | C-AQT | ANS; ; m=1; M=200 | None | 0 | 1 |
| | FDN | format description | C-AQT | ANS; ; m=1; M=200 | None | 0 | 1 |
| | ASC | acquisition special characteristics | O | ANS; ; m=1; M=200 | None | 0 | 1 |
| 20.015 | **SRF** | **SOURCE REPRESENTATION FORMAT** | M | | | 1 | 1 |
| | FTY | file type | M | AN; m=3; M=6 | None | 1 | 1 |
| | DEI | decoding instructions | O | ANS; m=1; M=1000 | None | 0 | 1 |
| 20.016 | **SEG** | **SEGMENTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | 99 |
| | RTV | segment reference type | M⇑ | N; m=1; M=3 | $1 \leq RTV \leq 126$ | 1 | 1 |
| | IPT | internal file reference pointer | M⇑ | N; m=1; M=5 | positive integer | 1 | 1 |
| | NOP | number of points | O⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 0 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour, up to the final point – for a total of NOP pairs | | | | | |
| | HPO | horizontal pixel offset | C-NOP | N; m=1; M=5 | positive integer value | 0 | NOP |
| | VPO | vertical pixel offset | C-NOP | N; m=1; M=5 | positive integer value | 0 | NOP |
| 20.017 | **SHPS** | **SCANNED HORIZONTAL PIXEL SCALE** | O; C-2D image | N; m=1; M=4 | positive integer value | 1 | 1 |
| 20.018 | **SVPS** | **SCANNED VERTICAL PIXEL SCALE** | O; C-2D image | N; m=1; M=4 | positive integer value | 1 | 1 |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 20.019 | **TIX** | **TIME INDEX** | M; C-Audio / video | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 99 |
| | TIS | time index start | M⇑ | NS; m=12; M=12 | $0 \leq hh \leq 99$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ $0 \leq sss \leq 999$ All above are positive integers | 1 | 1 |
| | TIE | time index end | M⇑ | NS; m=12; M=12 | $0 \leq hh \leq 99$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ $0 \leq sss \leq 999$ All above are positive integers | 1 | 1 |
| 20.020 | **COM** | **COMMENT** | O | ANS; m=1; M=126 | None | 0 | 1 |
| 20.021 | **SRN** | **SOURCE REPRESENTATION NUMBER** | M | N; m=1; M=3 | $0 \leq SRN \leq 255$ | 1 | 1 |
| 20.022 | **DUI** | **DEVICE UNIQUE IDENTIFIER** | O | AN; m=16; M=16 | first character of 16 = D, M, P or 0 | 0 | 1 |
| 20.023 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 20.024 | **MMS** | **MAKE / MODEL / SERIAL NUMBER** | O | | | 0 | 1 |
| | MAK | make | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| | MOD | model | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| | SER | serial number | M⇑ | ANS; m=1; M=50 | None | 1 | 1 |
| 20.025 – 20.099 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 20.100-20.900 | **UDF** | **USER DEFINED FIELDS** | O | user defined | user defined | | |
| 20.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 20.902 | **ANN** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[264] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $GMT \leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 20.903 - 20.993 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 20.994 | **EFR** | **EXTERNAL FILE REFERENCE** | O; C-Audio / video; C-DATA | ANS; m=1; M=200 | None | 0 | 1 |

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[264] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ".  In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 20.995 | **ASC** | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1; M=3 | $0 \le ACN \le 255$ | 1 | 1 |
| | ATV | segment reference type value | O⇑ | N; M=1; M=3 | $0 \le ATV \le 126$ | 1 | 1 |
| 20.996 | **HAS** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 entries | 0 | 1 |
| 20.997 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 20.998 | **GEO** | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[265] | $1900 \le YYYY$ $1 \le MM \le 12;$ $1 \le DD \le 31$ $1 \le HH \le 24$ $1 \le MM \le 59$ $1 \le SS \le 59$ All above are integer values $UTE \le$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=10 | $-90 \le LTD \le 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \le LTM \le 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \le LTS \le 60$ integer value | 0 | 1 |

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[265] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | LGD | longitude degree value | C-LTD | N; m=1; M=10 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 20.999 | **DATA** | **SOURCE REPRESENTATION DATA** | O; C-EFR | B | None | 1 | 1 |

### 8.20.1   Field 20.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

### 8.20.2   Field 20.002: Information designation character / IDC

This mandatory field shall be the IDC of this Type-20 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2**.

**8.20.3 Field 20.003: SRN description / SDE**

This mandatory field indicates how this record is being used,with a Value from **Table 84**.

**Table 84 SDE values**

| Value | Description |
|-------|-------------|
| S | The representation in this Type-20 record is the source of another Type-20 record |
| D | The representation in this Type-20 record is the source of one or more biometric type records, excluding Type-4 and Type-9, which have been derived from it |
| M | A single biometric type record, excluding Type-4 and Type-9, has been prepared from multiple Type-20 records |

**8.20.4 Field 20.004: Originating agency / ORG**

This is a mandatory field. See **Clause 7.16** for details.

**8.20.5 Field 20.005: Source representation date / SRD**

This optional field shall contain the date and time that the source representation contained in the record was captured. See **Clause 7.15.4 Local date and time** for details.

**8.20.6 Field 20.006: Horizontal line length / HLL**

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty.  See **Clause 7.19** for details.

**8.20.7 Field 20.007: Vertical line length / VLL**

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty.  See **Clause 7.19** for details.

**8.20.8 Field 20.008: Scale units / SLC**

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty.  See **Clause 7.19** for details.

**8.20.9 Field 20.009: Horizontal pixel scale / HPS**

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty.  See **Clause 7.19** for details.

### 8.20.10 Field 20.010: Vertical pixel scale / VPS

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.19** for details.

### 8.20.11 Field 20.011: Compression algorithm /CGA

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.22** for details.

### 8.20.12 Field 20.012: Bits per pixel / BPX

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.19** for details.

### 8.20.13 Field 20.013: Color space / CSP

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.19** for details.

### 8.20.14  Field 20.014: Acquisition source / AQS

This mandatory field shall specify and describe the acquisition source.

The first information item is mandatory. It is the **Acquisition source type / AQT** It shall be a numeric entry selected from the "attribute code' column of **Table 85**.

**Table 85 Acquisition source**

| Acquisition source type | Attribute code |
|---|---|
| Unspecified or unknown | 0 |
| Static photograph from an unknown source | 1 |
| Static photograph from a digital still-image camera | 2 |
| Static photograph from a scanner | 3 |
| Single video frame from an unknown source | 4 |
| Single video frame from an analog video camera | 5 |
| Single video frame from a digital video camera | 6 |
| Video sequence from an unknown source | 7 |
| Video sequence from an analog video camera, stored in analog format | 8 |
| Video sequence from an analog video camera, stored in digital format | 9 |
| Video sequence frame from a digital video camera | 10 |
| Computer screen image capture | 11 |
| Analog audio recording device; stored in analog form (such as a phonograph record) | 12 |
| Analog audio recording device; converted to digital | 13 |
| Digital audio recording device | 14 |
| Landline telephone – both sender and receiver | 15 |
| Mobile telephone – both sender and receiver | 16 |
| Satellite telephone – both sender and receiver | 17 |
| Telephone – unknown or mixed sources | 18 |
| Television – NSTC | 19 |
| Television – PAL | 20 |
| Television - Other | 21 |
| Radio transmission (incl. short-wave, AM, FM, satellite radio, aircraft communications, and others) | 22 |
| Vendor specific capture format | 23 |
| Other | 24 |

The second information item is mandatory if the acquisition source is analog, and the data is stored in digital format.  It is a text field, **Analog to digital conversion / A2D**, that describes the analog to digital equipment used to store a representation of the source.

The third information item is mandatory if the AQT is 23 or 24. It is a text field, **Format description / FDN**, that describes the format.

The fourth information item is optional. It is a free text field, **Acquisition special characteristics / ASC** that is used to describe any specific conditions not mentioned in the table. An example would be a near-infrared camera outputting images in visible wavelengths.

### 8.20.15 Field 20.015: Source representation format / SFT

This is a mandatory field comprised of two information items.

- o The first information item is mandatory. It is **File type / FTY**. If the source representation is a digital file, this shall contain the suffix indicating the file type. If it is an analog file, enter 'ANALOG'. For digital data stored in other formats (such as digital tape), enter 'OTHER'.
- o The second information item is **Decoding instructions / DEI**. It is optional and contains free text up to 1000 characters.

### 8.20.1 Field 20.016: Segments / SEG

This optional field shall consist of a subfield for each segment to be defined. Each subfield consists of a series of information items. See **Clause 7.23** for details.

### 8.20.2 Field 20.017: Scanned horizontal pixel scale / SHPS

This field is optional if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.19** for details.

### 8.20.3 Field 20.018: Scanned vertical pixel scale / SVPS

This field is optional if a 2D still image is contained in this instance of the record. Otherwise it shall remain empty. See **Clause 7.19** for details.

### 8.20.4 Field 20.019: Time Index / TIX

This is a conditional field. If the record contains video or audio, it shall contain the start and end times of segments within the file. See **Clause 7.15.5** for details.

### 8.20.5 Field 20.020: Comment / COM

This optional field may be used to insert comments or other text information with the representation data. See **Clause 7.22.**

### 8.20.6 Field 20.021: Source representation / SRN

This mandatory field contains a reference number for the source representation stored in this record. Note that the segment references are contained in **Field 20.016: Segments / SEG** , if they exist. This number corresponds to the SRN that may be referenced as the first information item in the SOR field of other Record Types. See **Clause 7.3.**

The SRN is a positive integer that uniquely refers to a particular instance of Record Type-20. It is a positive integer, numbered sequentially beginning at zero and incremented for each instance of Record Type-20.

### 8.20.7 Field 20.022: Device Unique Identifier / DUI

This is an optional field. See **Clause 7.24.1** for details.

### 8.20.8 Field 20.024: Make/Model/Serial Number / MAK / MOD / SER

This is an optional field. See **Clause 7.24.2** for details

### 8.20.9 Fields 20.100-900: User-defined fields / UDF

The size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.20.10 Field 20.902: Annotated Information / ANN

This is a mandatory field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Clause 7.5.**

### 8.20.11 Field 20.994: External file reference / EFR

This conditional field shall be used to enter the URL / URI or other unique reference to a storage location for all source representations EXCEPT 2D still images. For 2D images, they shall be included in this record in **Field 20.999: Source representation data / DATA**. If this field is used, **Field 20.999** shall not be set. However, one of the two fields shall be present in all instances of this record type. An non-URL reference might be similar to: "Case 2009:1468 AV Tape 5".

### 8.20.12 Field 20.995: Associated context / ASC

This is an optional field. See **Clause 7.4** for details.

### 8.20.13   Field 20.996: Hash/ HAS

This is an optional field. It shall contain the hash value of the source representation in the external file reference in **Field 20.994: External file reference / EFR** or the 2D still image in **Field 20.999: Source representation data / DATA** of this record, calculated using SHA 256. **See Clause 7.6**.

### 8.20.14   Field 20.998: Geographic sample location / GEO

This optional field contains the location where the original source was acquired – not where it is stored.  See **Clause 7.7**.

### 8.20.15   Field 20.999: Source representation data / DATA

If this field is used, **Field 20.994: External file reference / EFR** shall not be set. However, one of the two fields shall be present in all instances of this record type.  See **Clause 7.8** for details on the Data field entry.

Note that in Traditional format, this field shall be the last field in the record layout.

## 8.21 Record Type-21: Associated context record

The Type-21 record[266] contains an associated context record. This information does NOT contain information used to derive biometric information contained in other records. Record Type-20 serves that function. Record Type-21 may be used to convey contextual information, such as an image of the area where latent fingerprints were captured.

**Table 86 Type-21 record layout[267]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 21.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 21.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 \le IDC \le 255$ | 1 | 1 |
| 21.003 | **RSV** | **RESERVED FOR FUTURE USE** | | A; m=1; M=1 | | | |
| 21.004 | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |

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[266] New for this version to the standard.

[267] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 21.005 | **ACD** | **ASSOCIATED CONTEXT DATE** | M | Dependent upon encoding[268] | $1900 < YYYY$ $1 \leq MM \leq 12$ $1 < DD < 31$ $0 < hh < 59$ $0 < mm < 59$ integer values ACD < current date and time | 1 | 1 |
| 21.006 – 21.014 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 21.015 | **ACF** | **ASSOCIATED CONTEXT FORMAT** | M | | | 1 | 1 |
| | FTY | file type | M | AN; m=3; M=6 | None | 1 | 1 |
| | DEI | decoding instructions | O | ANS; m=1; M=1000 | None | 0 | 1 |
| 21.016 | **SEG** | **SEGMENTS** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | 99 |
| | RTV | segment reference type | M⇑ | N; m=1; M=3 | $1 \leq RTV \leq 126$ | 1 | 1 |
| | IPT | internal file reference pointer | M⇑ | N; m=1; M=5 | positive integer | 1 | 1 |
| | NOP | number of points | O⇑ | N; m=1; M=2 | $3 \leq NOP \leq 99$ | 0 | 1 |
| | | Note: following two information items are repeated as pairs, in order by point following the contour, up to the final point – for a total of NOP pairs | | | | | |
| | HPO | horizontal pixel offset | C-NOP | N; m=1; M=5 | positive integer | 0 | NOP |
| | VPO | vertical pixel offset | C-NOP | N; m=1; M=5 | positive integer | 0 | NOP |

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[268] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 21.017-21.018 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 21.019 | TIX | TIME INDEX | M; C-Audio / video | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 99 |
| | TIS | time index start | M⇑ | NS; m=12; M=12 | $0 \leq hh \leq 99$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ $0 \leq sss \leq 999$ All above are positive integers | 1 | 1 |
| | TIE | time index end | M⇑ | NS; m=12; M=12 | $0 \leq hh \leq 99$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ $0 \leq sss \leq 999$ All above are positive integers | 1 | 1 |
| 21.020 | COM | COMMENT | O | ANS; m=1; M=126 | None | 0 | 1 |
| 21.021 | ACN | ASSOCIATED CONTEXT NUMBER | M | N; m=1; M=3 | $0 \leq ACN \leq 255$ | 1 | 1 |
| 21.022-21.099 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 21.100-21.900 | UDF | USER DEFINED FIELDS | O | User-defined | User-defined | | |
| 21.901 | RSV | RESERVED FOR FUTURE USE | | | | | |

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 21.902 | **ANN** | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[269] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values GMT $\leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 21.903 – 21.993 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 21.994 | **EFR** | **EXTERNAL FILE REFERENCE** | O; C-Audio / video; C-DATA | ANS; m=1;M=35 | None | 0 | 1 |
| 21.996 | **HAS** | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |

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[269] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ". In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 21.997 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 21.998 | **GEO** | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[270] | $1900 \leq YYYY$<br>$1 \leq MM \leq 12$;<br>$1 \leq DD \leq 31$<br>$1 \leq HH \leq 24$<br>$1 \leq MM \leq 59$<br>$1 \leq SS \leq 59$<br>All above are integer values<br>UTE $\leq$ Today's date and time | 1 | 1 |
| | LTD | latitude degree value | O | N; m=1; M=8 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$<br>integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=8 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$<br>integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$<br>real number | 0 | 1 |

[270] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 21.999 | **DATA** | **ASSOCIATED CONTEXT DATA** | O; C-EFR | B | None | 1 | 1 |

### 8.21.1 Field 21.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.21.2 Field 21.002: Information designation character / IDC

This mandatory field shall be the IDC of this Type-21 record as found in **Field 1.003 Transaction content / CNT**. See **Clause 7.2**.

### 8.21.3 Field 21.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.21.4 Field 21.005: Associated context date / ACD

This optional field shall contain the date and time that the context representation contained in the record was captured. See **Clause 7.15.4 Local date and time** for details.

### 8.21.5 Field 21.015: Associated context format / AFT

This is a mandatory field comprised of two information items.

> o The first information item is mandatory. It is **File type / FTY**. If the source representation is a digital file, this shall contain the suffix

indicating the file type.  If it is an analog file, enter 'ANALOG'.  For digital data stored in other formats (such as digital tape), enter 'OTHER'.

- o The second information item is **Decoding instructions / DEI**.  It is optional and contains free text up to 1000 characters.

### 8.21.1 Field 21.016: Segments / SEG

This is an optional field. See **Clause 7.23** for details.

### 8.21.2 Field 21.019: Time Index / TIX

This field is mandatory for records containing video or audio, but not 2D still images. See **Clause 7.15.5** for details.

### 8.21.3 Field 21.020: Comment / COM

This optional field may be used to insert comments or other text information with the representation data.  See **Clause 7.22.**

### 8.21.4 Field 21.021: Associated context number / ACN

This mandatory field contains a reference number for the context representation stored in this record. Note that the segment references are contained in **Field 21.016: Segments / SEG**, if they exist.  This number corresponds to the SRN that may be referenced as the first information item in the SOR field of other Record Types**.  See Clause 7.4**.

The ACN is a positive integer that uniquely refers to a particular instance of Record Type-21.   It is a positive integer, numbered sequentially beginning at zero and incremented for each instance of Record Type-21.

### 8.21.5 Field 21.902: Annotated Information / ANN

This is an optional field, describing the operations performed on the data contained in this record.  See **Clause 7.5.**

### 8.21.6 Field 21.994: External file reference / EFR

This conditional field shall be used to enter the URL / URI or other unique reference to a storage location for all source representations EXCEPT 2D still images.  If this field is used, **Field 21.999: Associated context data / DATA** shall not be set.  However, one of the two fields shall be present in all instances of this record type. It is an alphanumeric entry, with special characters allowed. An non-URL reference might be similar to: "Case 2009:1468 AV Tape 5".

### 8.21.7 Field 21.996: Hash/ HAS

This optional field shall contain the hash value of the context representation in the external file reference in **Field 21.994: External file reference / EFR** or the 2D still image in **Field 21.999: Associated context data / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.21.8 Field 21.998: Geographic sample location / GEO

This optional field contains the location where the context information was acquired – not where it is stored. See **Clause 7.7**.

### 8.21.9 Field 21.999: Associated context data / DATA

If this field is used, **Field 21.994: External file reference / EFR** shall not be set. However, one of the two fields shall be present in all instances of this record type. See **Clause 7.8** for details on the Data field entry.

Note that in Traditional format, this field shall be the last field in the record layout.

## 8.22 Record Type-98: Information assurance record

The Type-98 record[271] shall contain security information that assures the authenticity and/or integrity of the transaction, possibly utilizing such techniques as binary data hashes, and/or digital signatures. Two mandatory fields in the IA Header are IAR Format Owner and IAR Format Type. The IAR Format Owner field denotes the vendor, standards body, working group, or industry consortium that has defined the format of the IA data (the data contained in the IAR). The values in the IAR Format Type field are assigned by the format owner and represent a specific IAR format as specified by the format owner. This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body. It is the combined IAR Format Owner/IAR Format Type value that uniquely identifies the IAR format.

There may be many instances of this Record Type per transaction.

The records that are protected by a Type-98 are all records other than the Type-98 itself.

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[271] New for this version of the standard.

**Table 87 Type-98 record layout[272]**

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 98.001 | | **RECORD HEADER** | M | | | 1 | 1 |
| 98.002 | **IDC** | **INFORMATION DESIGNATION CHARACTER** | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$ | 1 | 1 |
| 98.003 | **DFO** | **IAR FORMAT OWNER** | M | AN (hex); m=4; M=4 | Valid hex number | 1 | 1 |
| 98.004 | **ORG** | **ORIGINATING AGENCY** | M | | | 1 | 1 |
| | **ORI** | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | **OAN** | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |
| 98.005 | **DFT** | **IAR FORMAT TYPE** | M | ANS; m=1; M=20 | None | 1 | 1 |

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[272] Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| 98.006 | **DCD** | **IA DATA CREATION DATE** | M | Dependent upon encoding[273] | $1900 \leq YYYY$<br>$1 \leq MM \leq 12$;<br>$1 \leq DD \leq 31$<br>$0 \leq hh \leq 23$<br>$0 \leq mm \leq 59$<br>$0 \leq ss \leq 59$<br>All above are integer values<br>$DCD \leq$ Today's date and time | 1 | 1 |
| 98.007-98.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 98.200-98.899 | **UDF** | **USER-DEFINED FIELDS** | O | user-defined | user-defined | | |
| 98.900 | **ALF** | **IA AUDIT LOG** | M | | | 1 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | Unlimited |
| | EVT | event | M⇑ | A; m=5; M=9 | EVT = Added, Modified, Deleted or Corrupted | 1 | 1 |
| | EVR | event reason | M⇑ | ANS; m=1; M=200 | None | 1 | 1 |
| | IID | information identifier | M⇑ | ANS; m=15; M=30 | Field number exists, Repeat count valid for the field number, Mnemonic exists | 1 | 1 |
| | AGT | agent | M⇑ | AN; m=1; M=200 | | 1 | 1 |
| | LER | log entry reference | M⇑ | N; m=1; M=* | | 1 | 1 |

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[273] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ". In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max |
| | | *Multiple information items* | M⇑ | Conditional on original information format | None | 1 | Unlimited |
| 98.901-999 | RSV | **RESERVED FOR FUTURE USE** | | | | 1 | 1 |

### 8.22.1 Field 98.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this document for details. See **Clause 7.1**.

### 8.22.2 Field 98.002: Information designation character / IDC

This mandatory field shall be the IDC of this Type-98 record as found in **Field 1.003 Transaction content / CNT**. See **Clause 7.2**.

### 8.22.3 Field 98.003: IAR format owner / DFO

This mandatory field shall contain a four digit hex value assigned by an authoritative standards body which denote the vendor, standards body, working group, or industry consortium that has defined the format of the information assurance data (in the IAR). In an IA record the IAR Format Owner and Format Type (DRT), when used in combination uniquely identifies the specific format of the IAR content. This IAR format definition may be published (public) or unpublished (non-public).

### 8.22.4 Field 98.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.22.5 Field 98.005: IAR format type / DFT

This mandatory field shall be used to identify the value assigned by the format owner (DFO) to represent the specific IAR Format as specified by the format owner. This may be a nonstandard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body.

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### 8.22.6 Field 98.006: IA Data creation date / DCD

This mandatory field shall contain the date and time that IA data was created. The date and time shall appear as GMT format. See **Clause 7.15.2** for details.

### 8.22.7 Fields 98.200-899: User-defined fields / UDF

These fields are user-definable fields. Their size and content shall be defined by **Field 98.005: IAR format type / DFT** .

### 8.22.8 Field 98.900: IA Audit Log Field / ALF

This mandatory field consists of a series of statements (each corresponding to a repeating subfield) for each discrete change made to other logical records (e.g. types 1, 2, etc). The audit field shall be included within the protection scheme applied to all other records protected by the Type-98. Each ALF shall be marked with a **log entry reference / LER** so that one could reconstruct a particular ITL file version using a given ALF.

The ALF contains a series of repeating subfields. Each repeating subfield shall be composed of the following 6 information items:

- **Event / EVT** is the first information item. It is mandatory and shall contain textual information describing the event that occurred to the ITL record/field, and shall be chosen from the following controlled vocabulary:

    - Added
    - Modified
    - Deleted
    - Corrupted

- **Event reason / EVR** is the second information item. It states the rationale behind the Event that occurred. This information item is optional and should be populated with alphanumeric text with special characters up to 200 characters.

- **Information identifier / IID** is the third information item. It is mandatory and identifies the field/subfield/information item that has been affected by the Event. It is defined as the concatenation of the IDC, a comma, the Field Number in the ITL standard, a comma, the repeat count of the subfield (default = NA), a comma, and the information item mnemonic (if it exists). If a repeating subfield or information item does not exist, enter a "NA". Examples:

- 17,10.01,NA,BBC
- 3,9.373,4,NA
- 8,10.024,2,QVU

  For the case when a repeated subfield is removed, the entry for the repeat field number is the original repeat set count, preceded by a negative; the information item mnemonic is entered as "NA". When an information item is removed, the mnemonic is preceded by a negative. When an optional field is removed, the field number is preceded by a minus. Even though subfields and information items may have been in the field, the field number is followed by "NA,NA" so that the subfields and information items do not have to be individually listed.

- 12,10.024,-2,NA
- 6,18.016,NA,-AL3
- 5,-14.024,NA,NA

- **Agent / AGT** is the fourth information item. It is mandatory and shall contain information describing the entity (Agent) responsible for the EVT that affected the object identified by the IID. It is an alphanumeric entry of up to 200 characters with special characters allowed.

- **Log entry reference / LER** is the fifth information item. It is mandatory and contains a unique reference to the log entry.

- **The next information item(s) are the original values of the changed or deleted information items.** At least one information item is mandatory and shall contain the original value of the field before it was affected by the Event. In the case when a repeated subfield is removed, each separate information item or repeated value in the set shall be entered in order.

Note that one complete audit statement (subfield of ALF) shall be completed for each modified item of data.

## 8.10  Record Type-99: CBEFF biometric data record

The Type-99 record shall contain and be used to exchange biometric data that is not supported by other ANSI/NIST-ITL records.  This data is exchanged in a format that conforms to *INCITS 398-2005, the Common Biometric Exchange Formats Framework*.

The CBEFF conformant Biometric Information Record (BIR) used by the Type-99 record includes a common Header and a Biometric Data Block (BDB).  Two mandatory fields in the CBEFF Header are Format Owner and Format Type.  The Format Owner field denotes the vendor, standards body, working group, or industry consortium that has defined the format of the biometric data (the data contained in the BDB).  A CBEFF requirement is that format owners register with the IBIA for an assigned identifier of the format owner.  The values used in the Format Type field are assigned by the format owner and represent a specific.

The BDB format is specified by the format owner. This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body.  It is the combined CBEFF Format Owner/Format Type value that uniquely identifies the BDB format.  The Type-99 record provides the CBEFF fields necessary for users to send, receive, and interpret biometric data in any registered BDB format (with the exception of biometric data which is exchanged using the other records in this standard).  The data carried in **Field 99.999: Biometric data block / DATA** is the BDB.  The field's BDB Format Owner identifies the format of that data and BDB Format Type as described by the CBEFF standard.

**Table 88 Type-99 record layout**[274]

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 99.001 | | RECORD HEADER | M | | | 1 | 1 |
| 99.002 | IDC | INFORMATION DESIGNATION CHARACTER | M | N; m=1;M= 3 | $0 \leq IDC \leq 255$[275] | 1 | 1 |
| 99.003 | RSV | RESERVED FOR FUTURE USE | | | | | |
| 99.004[276] | ORG | ORIGINATING AGENCY | M | | | 1 | 1 |
| | ORI | originating agency identifier | M | ANS; m=1; M=35 | None | 1 | 1 |
| | OAN | originating agency name | O | ANS; m=1; M=125 | None | 0 | 1 |

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[274]Key for Character type: N=Numeric; NS = Numeric, with special characters; A=Alphabetic; AN=Alphanumeric; ANS = Alphanumeric with special characters; B=Binary or Base64;

Key for Cond code: M=Mandatory; O=Optional; C-xxx =Conditional on Mnemonic xxx value; M⇑=Mandatory if the field/repeating subfield is used; O⇑=Optional if the field/repeating subfield is used.

The Character count does NOT include special characters in Traditional encoding. m = minimum character count; M= Maximum character count. A value of "*" = not defined.

[275] This restriction had implicitly existed due to the Type-4 restriction of one byte for the IDC. However, it was never explicitly mentioned in earlier versions of the standard.

[276] Note the structure. In the 2007 version, only the Identifier was included in the field. In the 2008 version, the optional name was added. For consistency, the name is optional in this version.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 99.005 | **BCD** | **BIOMETRIC CAPTURE DATE** | M | Dependent upon encoding[277] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $BCD \leq$ Today's date and time | 1 | 1 |
| 99.006-99.099 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 99.100 | **HDV** | **CBEFF HEADER VERSION** | M | N; m=4; M=4 | =0101 | 1 | 1 |
| 99.101 | **BTY** | **BIOMETRIC TYPE** | M | N; m=8; M=8 | Value From **Table 90** | 1 | 1 |
| 99.102 | **BDQ** | **BIOMETRIC DATA QUALITY** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 9[278] |
| | QVU | quality value | M⇑ | N; m=1; M=3 | $0 \leq QVU \leq 100$ or $QVU = 254$ or $255$ integer value | 1 | 1 |
| | QAV | algorithm vendor identification | M⇑ | AN (hex digits); m =4; M=4 | 4 digit hex value | 1 | 1 |
| | QAP | algorithm product identification | M⇑ | N; m=1; M=5 | $1 \leq QAP \leq 65534$ integer value | 1 | 1 |
| 99.103 | **BFO** | **BDB FORMAT OWNER** | M | AN; m=4; M=4 | | 1 | 1 |
| 99.104 | **BFT** | **BDB FORMAT TYPE** | M | AN; m=4; M=4 | Valid Hex digits | 1 | 1 |

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[277] Traditional encoding is 8 characters (YYYYMMDD). XML inserts dashes and thus 10 characters (YYYY-MM-DD)

[278] This upper limit has been stated in this version to maintain consistency across all encodings and record types.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 99.105-99.199 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 99.200-99.900 | **UDF** | **USER DEFINED FIELDS** | O | user defined | user defined | | |
| 99.901 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |
| 99.902 | **ANN**[279] | **ANNOTATED INFORMATION** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | M⇑ | | | 1 | Unlimited |
| | GMT | Greenwich mean time | M⇑ | Dependent upon encoding[280] | $1900 \leq YYYY$ $1 \leq MM \leq 12$; $1 \leq DD \leq 31$ $0 \leq hh \leq 23$ $0 \leq mm \leq 59$ $0 \leq ss \leq 59$ All above are integer values $GMT \leq$ Today's date and time | 1 | 1 |
| | NAV | name and version of processing algorithm or workstation | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | OWN | name of owner | M⇑ | ANS; m= 1; M=64 | None | 1 | 1 |
| | PRO | process or procedure | M⇑ | ANS; m= 1; M=255 | None | 1 | 1 |
| 99.903-99.994 | **RSV** | **RESERVED FOR FUTURE USE** | | | | | |

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[279] New for this version of the standard.

[280] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ". In XML it is "YYYY-MM-DDTHH : MM : SSZ" for a total of 24 characters, including "-" " " and ":". Note that T and Z are fixed characters.

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| 99.995 | **ASC**[281] | **ASSOCIATED CONTEXT** | O | | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | ACN | associated context number | M⇑ | N; m=1;M=3 | $1 \leq ACN \leq 255$ integer value | 1 | 1 |
| | ASP | associated segment position | O⇑ | N; m=1; M=2 | $1 \leq ASP \leq 99$ integer value | 0 | 1 |
| 99.996 | **HAS**[281] | **HASH** | O | Base 64; m=64; M=64 | Valid Base 64 values | 0 | 1 |
| 99.997 | **SOR**[281] | **SOURCE REPRESENTATION** | O | N; m=1; M=3 | | 0 | 1 |
| | | *Subfields: Repeating sets of information items* | | | | 1 | 255 |
| | SRN | source representation number | M⇑ | N; m=1;M=3 | $1 \leq SRN \leq 255$ Integer value | 1 | 1 |
| | RTV | segment position | O⇑ | N; m=1; M=2 | $1 \leq RTV \leq 99$ Integer value | 0 | 1 |
| 99.998 | **GEO**[281] | **GEOGRAPHIC SAMPLE ACQUISITION LOCATION** | O | | | 0 | 1 |
| | UTE | universal time entry | M⇑ | Dependent upon encoding[282] | $1900 \leq YYYY$ $1 \leq MM \leq 12;$ $1 \leq DD \leq 31$ $1 \leq HH \leq 24$ $1 \leq MM \leq 59$ $1 \leq SS \leq 59$ All above are integer values UTE $\leq$ Today's date and time | 1 | 1 |

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[281] New for this version of the standard.

[282] In Traditional encoding it is 15 characters: "YYYYMMDDHHMMSSZ-hhmm". The minus may be a plus. In XML it is "YYYY-MM-DDTHH : MM : SSZ-hh : mm" for a total of 32 characters, including "-"

| Field number | Mnemonic (Fields, information items) | Content Description | Cond code | Character Type and min (m) / Max (M) Character count | Value Constraints | Occurrence count | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Min** | **Max** |
| | LTD | latitude degree value | O | N; m=1; M=8 | $-90 \leq LTD \leq 90$ | 0 | 1 |
| | LTM | latitude minute value | C-LTD | N; m=1; M=5 | $0 \leq LTM \leq 60$ | 0 | 1 |
| | LTS | latitude second value | C-LTD | N; m=1; M=2 | $0 \leq LTS \leq 60$ integer value | 0 | 1 |
| | LGD | longitude degree value | C-LTD | N; m=1; M=8 | $-180 \leq LGD \leq 180$ | 0 | 1 |
| | LGM | longitude minute value | C-LGD | N; m=1; M=5 | $0 \leq LGM \leq 60$ | 0 | 1 |
| | LGS | longitude second value | C-LGD | N; m=1; M=2 | $0 \leq LGS \leq 60$ integer value | 0 | 1 |
| | ELE | elevation | O | N; m-1; M=8 | $-422.000 < ELE < 8848.000$ real number | 0 | 1 |
| | GDC | geodetic datum code | O | AN; m=2; M=32 | Default = WGE | 0 | 1 |
| | GCM | geographic coordinate universal Mercator zone | O | AN; m=4; M=4 | $1 \leq GCM \leq 60$ integer value | 0 | 1 |
| | GCE | geographic coordinate universal transverse Mercator easting | C-GCM | N; m=2; M=5 | $0 \leq GCE$ real number | 0 | 1 |
| 99.999 | **DATA** | **BIOMETRIC DATA BLOCK** | B | B; m=1; M=* | None | 1 | 1 |

### 8.10.1    Field 99.001: Record header

The content of this mandatory field is dependent upon the encoding used.  See the relevant annex of this document for details.  See **Clause 7.1**.

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" " and ":". Note that T and Z are fixed characters.

### 8.10.2 Field 99.002: Information designation character / IDC

This mandatory field shall be the IDC of this Type-99 record as found in **Field 1.003 Transaction content / CNT**.  See **Clause 7.2**.

### 8.10.3 Field 99.004: Originating agency / ORG

This is a mandatory field. See **Clause 7.16** for details.

### 8.10.4 Field 99.005: Biometric creation date / BCD

This is a mandatory field. See **Clause 7.15.2** for details.

### 8.10.5 Field 99.100: CBEFF header version / HDV

This mandatory ASCII field shall be used to identify the version of CBEFF specification that this record conforms to.  The format is two characters for major version number followed by two characters for minor version.  The version of CBEFF in *INCITS 398-2005* is represented by the string '0101' (major version '01' and minor version '01').

### 8.10.6 Field 99.101: Biometric type / BTY

This mandatory field shall be used to identify the biometric modality.  This specification adopts the values presented in CBEFF with the addition of two leading zeros for future expansion. **Table 89** lists the current biometric type codes for modalities not covered in this standard with specific Record Types assigned to them.[283]

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[283] Previous versions of the standard included biometric types with record types now included in the standard.  For those Biometric Type Codes, see *ANSI/NIST-ITL 1-2007*, Table 39.

**Table 89 CBEFF Biometric type**

| Biometric Type Name | Biometric Type Code |
|---|---|
| No Information Given | '00000000' |
| Multiple Biometrics Used | '00000001' |
| Voice | '00000004' |
| Retina | '00000020' |
| Hand Geometry | '00000040' |
| Signature Dynamics | '00000080' |
| Keystroke Dynamics | '00000100' |
| Lip Movement | '00000200' |
| Thermal Face Image | '00000400' |
| Thermal Hand Image | '00000800' |
| Gait | '00001000' |
| Body Odor | '00002000' |
| Ear Shape | '00008000' |
| Finger Geometry | '00010000' |
| Vein Pattern | '00040000' |

### 8.10.7   Field 99.102: Biometric data quality / BDQ

This optional field is used to specify a quality score for the biometric data stored in the BDB in this record. This field is comprised of three information items. See **Clause 7.18** for details.

### 8.10.8   Field 99.103: BDB format owner / BFO

This mandatory field shall be used to denote the vendor, standards body, working group, or industry consortium that has defined the format of the biometric data (in the BDB).  In a CBEFF structure the BDB Format Owner and Format Type, when used in combination, uniquely identify the specific format of the BDB content.  The format and content of the BDB is "owned" by the CBEFF Client (see Clause 6.1 of the CBEFF standard).  This BDB format definition may be published (public) or unpublished (non-public).

A CBEFF requirement is that format owners register with IBIA for an assigned identifier of the format owner. The number is guaranteed to be unique.  Refer to the CBEFF standard, Clause 6, "CBEFF Patrons and Clients," for registration information. The four hex digits assigned by IBIA shall be represented by a string of four characters.

### 8.10.9   Field 99.104: BDB format type / BFT

This mandatory field shall be used to identify the value assigned by the format owner to represent the specific BDB Format as specified by the format owner.  This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body.  The registration of the Format Type value is recommended but not required.  Refer to the CBEFF standard, Clause 6, "CBEFF Patrons and Clients," for registration information The four hex digits assigned by the format owner shall be represented by a string of four characters.

### 8.10.10  Fields 99. 200-900: User-defined fields / UDF

These fields are user-definable fields.  Their size and content shall be defined by the user and be in accordance with the receiving agency.

### 8.10.11  Field 99.902: Annotated Information / ANN[284]

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type.  See **Clause 7.5.**

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[284] New for this version of the standard.

### 8.10.12  Field 99.995: Associated context / ASC

This optional field[285] refers to one or more Record Type-21 with the same ACN. See **Clause 7.4.**

### 8.10.13  Field 99.996: Hash/ HAS

This optional field[285] shall contain the hash value of the image in **Field 99.999: Biometric data block / DATA** of this record, calculated using SHA 256. See **Clause 7.6**.

### 8.10.14  Field 99.997: Source representation / SOR

This optional field[285] refers to a representation in Record Type-20 with the same SRN. See **Clause 7.3.**

### 8.10.15  Field 99.998: Geographic sample acquisition location / GEO

This optional field[285] contains the location where the biometric sample was acquired – not where it is stored.  See **Clause 7.7**.

### 8.10.16  Field 99.999: Biometric data block / DATA

This mandatory field[286] shall contain the CBEFF Biometric Data Block (BDB). See **Clause 7.8** for details on the Data field entry.  In Traditional encoding, this shall be the last physical field in the record.

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[285] New for this version of the standard.

[286] In previous versions of the standard, the mnemonic used here was BDB.  It has been changed to be consistent with the other record types.

**Annex A Character encoding sets**

**Normative**

**Field 1.015 Directory of character encoding sets / DCS** allows the user to specify the character encoding set for certain record types, as described in Clause 5.4. This Annex lists the codes for the different characters commonly used. Note that UTF-8 and UTF-16BE allow for special national characters, such as the Greek letters (like Ω), the Spanish special letters (like ñ), the German special letters (like ß), the French special letters (like ç), Chinese characters (like 文), Cyrillic letters (like Ю), Korean syllabics (like 꽈), Hebrew letters (like ש), Thai letters (like น), Japanese letters (like ぼ), Tamil letters (like ஒண) and Arabic letters (like ب), among others. **Table 93** does not list these characters, except for a few examples. In **Table 93**, the character ç is in the 8-bit Latin set, unlike the English language characters, which are in the 7-bit (default) character encoding set. The Chinese character 白 is not in the 8-bit Latin character set, but it is in UTF-8. The character ф is not available in UTF-8. When using these extended character sets, they shall be used as alphanumeric special (ANS) characters.

Base-64 is represented identically to US ASCII and EBCDIC. Other representations may not share this property. The encoding process represents 24-bit groups as strings of 4 encoded characters. Proceeding from left to right, concatenating three 8-bit input groups forms a 24-bit group. These 24 bits are treated a 4 concatenated 6-bit groups, each of which is translated into a single digit in the Base-64 alphabet. When encoding a bit stream via the Base-64 encoding, the bit stream shall be ordered with the most significant bit first. Base-64 column show the output encoding (character name) for the 6-bit value in the Base-64 column. The character "=" is used for padding. Any characters outside of the Base-64 alphabet shall be ignored in information items designated as using Base-64 input. Text line breaks in the input being translated to Base-64 shall be converted to CRLF sequences prior to Base-64 encoding. An example of Base-64 encoding is shown below.

**Table 90 Base-64 Conversion Example**

| Text | M | A | | | ß | |
|---|---|---|---|---|---|---|
| Binary encoding of input (8-bits) | 0 1 0 0 1 1 0 1 | 0 1 1 0 0 0 0 1 | | | 1 1 0 1 1 1 1 1 | |
| **6-bit binary** | **0 1 0 0 1 1** | **0 1 0** | **0 1 1** | **0 0 0 1** | **1 1** | **0 1 1 1 1 1** |
| **Base-64 value** | T | W | | H | | f |

UTF-8 encoding is variable width.  The first 128 characters use one byte and are equivalent to US-ASCII.  The next 1,920 characters require two bytes to encode.  Three and four bytes are also possible for certain, more rare characters.  Note that for the non US-ASCII characters, the UTF-8 and UTF-16 encodings are substantially different.  There also may not be a noticeable relationship between the UNICODE code pointer and the UTF-8 and UTF-16 values.

The following tables illustrate the conversion of Binary and UTF-8.

**Table 91 UNICODE conversion to UTF-8**

| Unicode pointer | Code Point | UTF-8 bytes | Example |
|---|---|---|---|
| U+0000 to U+007F | aaaaaaaa | aaaaaaaa | U+0024 ($)<br>=  0010 0100  (drop leading zeros)<br>→ 0010 0100<br>→ 0x24 |
| U+0080 to U+07FF | 00000aaa<br>aabbbbbb | 110aaaaa<br>10bbbbbb | U+00E7 (ç)<br>=  0000 0000 1110 0111<br>→1100 0011  1010 0111<br>→ 0xC3  0xA7 |
| U+0800 to U+FFFF | aaaabbbb<br>bbcccccc | 1110aaaa<br>10bbbbbb<br>10cccccc | U+767D (白)<br>=  0111 0110 0111 1110<br>→ 1110 0111 1001 1001 1011 1110<br>→  0xE7  0x99  0xBD |
| U+010000 to U+10FFFF | 000aaabb<br>bbbbcccc<br>ccdddddd | 11110aaa<br>10bbbbbb<br>10cccccc<br>10dddddd | U+01D11E (𝄞)<br>= 0000 0001 1110 0001 0001 1110<br>→ 1111 0000 1001 1110 1000 0100 1001 1110<br>→0xF0  0x9D  0x84  0x9E |

**Table 92 UNICODE conversion to UTF-16**

| Unicode pointer | Code Point | UTF-16 bytes | Example |
|---|---|---|---|
| U+0000 to U+D7FF And U+E000 to U+FFFF | aaaa aaaa aaaa aaaa | aaaa aaaa aaaa aaaa | U+0024 ($)<br>= 0000 0000 0010 0100<br>(do not drop leading zeros)<br>→ 0000 0000 0010 0100<br>→ 0x00 0x24<br>UTF-16 bytes: 0000 0000 0010 0100 |
| U+10000 to U+10FFFD | aaaa aaaa aaaa aaaa aaaa<br><br>To<br><br>aaaa aaaa aaaa aaaa aaaa aaaa | bbbb bbbb bbbb bbbb cccc cccc cccc cccc | U+1D11E (𝄞)<br>= 0001 1110 0001 0001 1110<br>        Subtract 0x10000<br>= 0000 1110 0001 0001 1110<br>high 10 bits = 00 0011 1000; low 10 bits = 01 0001 1110<br>Add 0xD800 to the high bits: 1101 1000 0000 0000 (D 8 0 0)<br>     +      00 0011 1000  (high bits)<br>Equals the first code unit:   1101 1000 0011 1000<br>= 0xD834<br>Add 0xDC00 to the low bits:  1101 1100 0000 0000 (D C 0 0)<br>     +      01 0001 1110 (low bits)<br>Equals the seCond code unit:  1101 1101 0001 1110<br>= 0xDD1E<br>Final UTF-16 code: D834,DD1E<br>UTF-16 bytes: 1101 1000 0011 1000<br>                1101 1101 0001 1110 |

**Table 93 Character encoding set values**

| Character Name | Type (A, N, ANS) | US-ASCII Code point | ASCII Left 0 + 7-bit Binary | Base-64 6-bit Binary | Unicode Code point | UTF-8 Byte encoding Hex | UTF-16BE Byte encoding Hex |
|---|---|---|---|---|---|---|---|
| $^F_S$ (Traditional encoding – the record separator) | | 0x28 | 0 0011100 | | U+001C | | |
| $^G_S$ (Traditional encoding – the field separator) | | 0x29 | 0 0011101 | | U+001D | | |
| $^R_S$ (Traditional encoding – the repeating subfield separator) | | 0x30 | 0 0011110 | | U+001E | | |
| $^U_S$ (Traditional encoding – the information item separator) | | 0x31 | 0 0011111 | | U+001F | | |
| Space | A | 0x32 | 0 0100000 | | U+0020 | 20 | 00 20 |
| ! | A | 0x33 | 0 0100001 | | U+0021 | 21 | 00 21 |
| " | A | 0x34 | 0 0100010 | | U+0022 | 22 | 00 22 |
| # | ANS | 0x35 | 0 0100011 | | U+0023 | 23 | 00 23 |
| $ | ANS | 0x36 | 0 0100100 | | U+0024 | 24 | 00 24 |
| % | ANS | 0x37 | 0 0100101 | | U+0025 | 25 | 00 25 |
| & | ANS | 0x38 | 0 0100110 | | U+0026 | 26 | 00 26 |
| ' | A | 0x39 | 0 0100111 | | U+0027 | 27 | 00 27 |
| ( | A | 0x40 | 0 0101000 | | U+0028 | 28 | 00 28 |
| ) | A | 0x41 | 0 0101001 | | U+0029 | 29 | 00 29 |
| * | ANS | 0x42 | 0 0101010 | | U+002A | 2a | 00 2a |
| + | A , N | 0x43 | 0 0101011 | 111110 | U+002B | 2b | 00 2b |
| , | ANS | 0x44 | 0 0101100 | | U+002C | 2c | 00 2c |

| Character Name | Type (A, N, ANS) | US-ASCII Code point | ASCII Left 0 + 7-bit Binary | Base-64 6-bit Binary | Unicode Code point | UTF-8 Byte encoding Hex | UTF-16BE Byte encoding Hex |
|---|---|---|---|---|---|---|---|
| < | ANS | 0x60 | 0 0111100 | | | | |
| - | A, N | 0x45 | 0 0101101 | | U+002D | 2d | 00 2d |
| . | A, N | 0x46 | 0 0101110 | | U+002E | 2e | 00 2e |
| / | ANS | 0x47 | 0 0101111 | 111111 | | | |
| 0 | N | 0x48 | 0 0110000 | 110100 | U+0030 | 30 | 00 30 |
| 1 | N | 0x49 | 0 0110001 | 110101 | U+0031 | 31 | 00 31 |
| 2 | N | 0x50 | 0 0110010 | 110110 | U+0032 | 32 | 00 32 |
| 3 | N | 0x51 | 0 0110011 | 110111 | U+0033 | 33 | 00 33 |
| 4 | N | 0x52 | 0 0110100 | 111000 | U+0034 | 34 | 00 34 |
| 5 | N | 0x53 | 0 0110101 | 111001 | U+0035 | 35 | 00 35 |
| 6 | N | 0x54 | 0 0110110 | 111010 | U+0036 | 36 | 00 36 |
| 7 | N | 0x55 | 0 0110111 | 111011 | U+0037 | 37 | 00 37 |
| 8 | N | 0x56 | 0 0111000 | 111100 | U+0038 | 38 | 00 38 |
| 9 | N | 0x57 | 0 0111001 | 111101 | U+0039 | 39 | 00 39 |
| = | ANS | 0x61 | 0 0111101 | pad | U+003D | 3d | 00 3d |
| > | ANS | 0x62 | 0 0111110 | | | | |
| ? | A | 0x63 | 0 0111111 | | U+003F | 3f | 00 3f |
| @ | ANS | 0x64 | 0 1000000 | | U+0040 | 40 | 00 40 |
| A | A | 0x65 | 0 1000001 | 000000 | U+0041 | 41 | 00 41 |
| B | A | 0x66 | 0 1000010 | 000001 | U+0042 | 42 | 00 42 |
| C | A | 0x67 | 0 1000011 | 000010 | U+0043 | 43 | 00 43 |
| D | A | 0x44 | 0 1000100 | 000011 | U+0044 | 44 | 00 44 |
| E | A | 0x45 | 0 1000101 | 000100 | U+0045 | 45 | 00 45 |
| F | A | 0x46 | 0 1000110 | 000101 | U+0046 | 46 | 00 46 |
| G | A | 0x47 | 0 1000111 | 000110 | U+0047 | 47 | 00 47 |
| H | A | 0x48 | 0 1001000 | 000111 | U+0048 | 48 | 00 48 |

| Character Name | Type (A, N, ANS) | US-ASCII Code point | ASCII Left 0 + 7-bit Binary | Base-64 6-bit Binary | Unicode Code point | UTF-8 Byte encoding Hex | UTF-16BE Byte encoding Hex |
|---|---|---|---|---|---|---|---|
| I | A | 0x49 | 0 1001001 | 001000 | U+0049 | 49 | 00 49 |
| J | A | 0x4A | 0 1001010 | 001001 | U+004A | 4a | 00 4a |
| K | A | 0x4B | 0 1001011 | 001010 | U+004B | 4b | 00 4b |
| L | A | 0x4C | 0 1001100 | 001011 | U+004C | 4c | 00 4c |
| M | A | 0X4D | 0 1001101 | 001100 | U+004D | 4d | 00 4d |
| N | A | 0x4E | 0 1001110 | 001101 | U+004E | 4e | 00 4e |
| O | A | 0x4F | 0 1001111 | 001110 | U+004F | 4f | 00 4f |
| P | A | 0x50 | 0 1010000 | 001111 | U+0050 | 50 | 00 50 |
| Q | A | 0x51 | 0 1010001 | 010000 | U+0051 | 51 | 00 51 |
| R | A | 0x52 | 0 1010010 | 010001 | U+0052 | 52 | 00 52 |
| S | A | 0x53 | 0 1010011 | 010010 | U+0053 | 53 | 00 53 |
| T | A | 0x54 | 0 1010100 | 010011 | U+0054 | 54 | 00 54 |
| U | A | 0x55 | 0 1010101 | 010100 | U+0055 | 55 | 00 57 |
| W | A | 0x57 | 0 1010111 | 010110 | U+0057 | 57 | 00 57 |
| X | A | 0x58 | 0 1011000 | 010111 | U+0058 | 58 | 00 58 |
| Y | A | 0x59 | 0 1011001 | 011000 | U+0059 | 59 | 00 59 |
| Z | A | 0x5A | 0 1011010 | 011001 | U+005A | 5a | 00 5a |
| [ | ANS | 0x5B | 0 1011011 | | U+005B | 5b | 00 5b |
| \ | ANS | 0x5C | 0 1011100 | | U+005C | 5c | 00 5c |
| ] | ANS | 0x5D | 0 1011101 | | U+005D | 5d | 00 5e |
| ^ | ANS | 0x5E | 0 1011110 | | U+005E | 5e | 00 5e |
| _ | ANS | 0x5F | 0 1011111 | | U+005F | 5f | 00 5f |
| ` | ANS | 0x60 | 0 1100000 | | U+0060 | 60 | 00 60 |
| a | A | 0x61 | 0 1100001 | 011010 | U+0061 | 61 | 00 61 |
| b | A | 0x62 | 0 1100010 | 011011 | U+0062 | 62 | 00 62 |
| c | A | 0x63 | 0 1100011 | 011100 | U+0063 | 63 | 00 63 |
| d | A | 0x64 | 0 1100100 | 011101 | U+0064 | 64 | 00 64 |
| e | A | 0x65 | 0 1100101 | 011110 | U+0065 | 65 | 00 65 |
| f | A | 0x66 | 0 1100110 | 011111 | U+0066 | 66 | 00 66 |
| g | A | 0x67 | 0 1100111 | 100000 | U+0067 | 67 | 00 67 |
| h | A | 0x68 | 0 1101000 | 100001 | U+0068 | 68 | 00 68 |
| i | A | 0x69 | 0 1101001 | 100010 | U+0069 | 69 | 00 69 |
| j | A | 0x6A | 0 1101010 | 100011 | U+006A | 6a | 00 6a |
| k | A | 0x6B | 0 1101011 | 100100 | U+006B | 6b | 00 6b |

| Character Name | Type (A, N, ANS) | US-ASCII Code point | ASCII Left 0 + 7-bit Binary | Base-64 6-bit Binary | Unicode Code point | UTF-8 Byte encoding Hex | UTF-16BE Byte encoding Hex |
|---|---|---|---|---|---|---|---|
| l | A | 0x6C | 0 1101100 | 100101 | U+006C | 6c | 00 6c |
| m | A | 0x6D | 0 1101101 | 100110 | U+006D | 6d | 00 6d |
| n | A | 0x6E | 0 1101110 | 100111 | U+006E | 6e | 00 6e |
| o | A | 0x6F | 0 1101111 | 101000 | U+006F | 6f | 00 6f |
| p | A | 0x70 | 0 1110000 | 101001 | U+0070 | 70 | 00 70 |
| q | A | 0x71 | 0 1110001 | 101010 | U+0071 | 71 | 00 71 |
| r | A | 0x72 | 0 1110010 | 101011 | U+0072 | 72 | 00 72 |
| s | A | 0x73 | 0 1110011 | 101100 | U+0073 | 73 | 00 73 |
| t | A | 0x74 | 0 1110100 | 101101 | U+0074 | 74 | 00 74 |
| u | A | 0x75 | 0 1110101 | 101110 | U+0075 | 75 | 00 75 |
| v | A | 0x76 | 0 1110110 | 101111 | U+0076 | 76 | 00 76 |
| w | A | 0x77 | 0 1110111 | 110000 | U+0077 | 77 | 00 77 |
| x | A | 0x78 | 0 1111000 | 110001 | U+0078 | 78 | 00 78 |
| y | A | 0x79 | 0 1111001 | 110010 | U+0079 | 79 | 00 79 |
| z | A | 0x7A | 0 1111010 | 110011 | U+007A | 7a | 00 7a |
| { | ANS | 0x7B | 0 1111011 | | U+007B | 7b | 00 7b |
| \| | ANS | 0x7C | 0 1111100 | | U+007C | 7c | 00 7c |
| } | ANS | 0x7D | 0 1111110 | | U+007D | 7d | 00 7d |
| ~ | ANS | 0x7E | 01111110 | | U+007E | 7e | 00 7e |
| Start-of-text "STX" | | 0x02 | 0 0000010 | | U+0002 | | |
| End-of-text "ETX" | | 0x03 | 0 0000011 | | U+0003 | | |
| **Special character examples** | | **Latin ASCII Code Point** | **Latin ASCII 8-bit Binary** | | | | |
| Example: ç | ANS | 0x87 | 10000111 | | U+00E7 | c3 a7 | 00 e7 |
| Example: 白 | ANS | | | | U+767D | e7 99 bd | 76 7d |
| Example: 𝄞 | ANS | | | | U+1D11E | f0 9d 84 9e | d8 34 dd 1e |

# Annex B Traditional encoding

## Normative

The Traditional Encoding is the encoding used in all versions of the standard prior to 2008. The format and rules for this encoding of the *ANSI/NIST-ITL 1-2011* version are consistent with *ANSI/NIST-ITL 1-2007*.

The types of logical records together with the identifier and type of data for each record type are listed in **Table 94**.

**Table 94 Logical record types**

| Record Identifier | Logical record contents | Type of data |
|---|---|---|
| 1 | Transaction information | ASCII |
| 2 | User-defined descriptive text | ASCII |
| 3 | Low-resolution  grayscale fingerprint image | Deprecated |
| 4 | High-resolution grayscale fingerprint image | Binary |
| 5 | Low-resolution binary fingerprint image | Deprecated |
| 6 | High-resolution binary fingerprint image | Deprecated |
| 7 | User-defined image | Binary |
| 8 | Signature image | Binary |
| 9 | Minutiae data | ASCII |
| 10 | Facial & SMT image | ASCII/Binary |
| 11 | Voice record | Reserved for future use |
| 12 | Dental record | Reserved for future use |
| 13 | Variable-resolution latent friction ridge image | ASCII/Binary |
| 14 | Variable-resolution fingerprint image | ASCII/Binary |
| 15 | Variable-resolution palmprint Image | ASCII/Binary |
| 16 | User-defined variable-resolution testing Image | ASCII/Binary |
| 17 | Iris image | ASCII/Binary |
| 18 | DNA data | ASCII/Binary |

| Record Identifier | Logical record contents | Type of data |
|---|---|---|
| 19 | Variable-resolution plantar image | ASCII/Binary |
| 20 | Source representation | ASCII/Binary |
| 21 | Associated context data | ASCII/Binary |
| 22-97 | Reserved for future use | ASCII/Binary |
| 98 | Information assurance | ASCII/Binary |
| 99 | CBEFF Biometric data record | ASCII/Binary |

The first field in all records shall be labeled as field "1" and contain the length in bytes of the record. With the exception of the Type-1 record (See **Clause 8.1**), the second field shall be labeled as field "2" and contain the information designation character (IDC). See **Clause 7.2.**

The data in the Type-1 record shall always be recorded in variable length fields using the 7-bit American National Standard Code for Information Interchange (ASCII) as described in *ISO/IEC 10646*[287]. For purposes of compatibility, the eighth (leftmost) bit shall contain a value of zero. All field numbers and information separators shall be recorded in 7-bit ASCII as described in *ISO/IEC 10646*.

Textual fields in Record Types 10-99 may occur in any order after the first two fields and contain the information as described for that particular numbered field, except for field 999, which shall be the concluding field, when it is included in a record. The allowed character encoding sets are included in **Table 2**.

In the Type-1, Type-2, Type-9 through Type-99 record information is delimited by the four ASCII information separators. The delimited information may be items within a field or subfield, fields within a logical record, or multiple occurrences of subfields. These information separators are defined in the referenced standard *ISO/IEC 10646* whose code table is shown in **Table 95**. These characters are used to separate and qualify information in a logical sense. Viewed in a hierarchical relationship, the File Separator "$^F$S" character is the most inclusive followed by the Group Separator "$^G$S", the Record Separator "$^G$S", and finally the Unit Separator "$^U$S" characters.

---

[287] ISO/IEC 10646 – *Information technology -- Universal Multiple-Octet Coded Character Set (UCS)*

## Table 95 Seven-bit American Standard Code for Information Interchange (ASCII)

| B$_7$ = M S B → | | | | | 0 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b$_6$ → | | | | | | | | | | | | |
| b$_5$ → | | | | | | | | | | | | |
| **B i t s** | b$_4$ ↓ | b$_3$ ↓ | b$_2$ ↓ | b$_1$ ↓ | **COLUMN →** ROW ↓ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | 0 | 0 | 0 | 0 | 0 | N U L | D L E | S P | 0 | @ | P | N | p |
| | 0 | 0 | 0 | 1 | 1 | S O H | D C 1 | ! | 1 | A | Q | a | q |
| | 0 | 0 | 1 | 0 | 2 | S T X | D C 2 | " | 2 | B | R | b | r |
| | 0 | 0 | 1 | 1 | 3 | E T X | D C 3 | # | 3 | C | S | c | s |
| | 0 | 1 | 0 | 0 | 4 | E O T | D C 4 | $ | 4 | D | T | d | t |
| | 0 | 1 | 0 | 1 | 5 | E N Q | N A K | % | 5 | E | U | e | u |
| | 0 | 1 | 1 | 0 | 6 | A C K | S Y N | & | 6 | F | V | f | v |
| | 0 | 1 | 1 | 1 | 7 | B E L | E T B | N | 7 | G | W | g | w |
| | 1 | 0 | 0 | 0 | 8 | B S | C A N | ( | 8 | H | X | h | x |
| | 1 | 0 | 0 | 1 | 9 | H T | E M | ) | 9 | I | Y | i | y |
| | 1 | 0 | 1 | 0 | 10 | L F | S U B | * | : | J | Z | j | z |
| | 1 | 0 | 1 | 1 | 11 | V T | E S C | + | ; | K | [ | K | { |
| | 1 | 1 | 0 | 0 | 12 | F F | F S | , | < | L | \ | * | | |
| | 1 | 1 | 0 | 1 | 13 | C R | G S | - | = | M | ] | m | } |
| | 1 | 1 | 1 | 0 | 14 | S O | R S | . | > | N | ^ | n | ~ |
| | 1 | 1 | 1 | 1 | 15 | S I | U S | / | ? | O | _ | o | D E L |

The four characters are only meaningful when used as separators of data items in the

fields of the ASCII text records. There is no specific meaning attached to these characters occurring in binary sample records and binary fields – they are just part of the exchanged data. Information separators should be functionally viewed as an indication of the type data that follows.

The "$^U_S$" character shall separate individual information items within a field or subfield. This is a signal that the next information item is a piece of data for that field or subfield. Multiple subfields within a field separated by the "$^U_S$" character signal the start of the next group of repeated information item(s).

The "$^G_S$" separator character used between information fields signals the beginning of a new field preceding the field identifying number that shall appear.

Multiple records within a transaction are separated by the "$^F_S$" character, which signals the end of a logical record.

Use of separators within the Type-1, Type-2, Type-9 through Type-99 records shall always be observed. The "$^U_S$" separator shall separate multiple items within a field or subfield; the "$^R_S$" separator shall separate multiple subfields, and the "$^G_S$" separator shall separate information fields.

The following is a detailed description of the separator characters.

**FN**   is the number of a field (including record type) within a record, other than Types 4, 7 or 8.

**IF**   is the information field associated with an FN.

**II**   is the information item belonging to an IF.

**SF**   is the subfield used for multiple entries of an II or an IF.

$^F_S$   File separator character – separates logical records.

$^G_S$   Group separator character – separates fields.

$^R_S$   Record separator character – separates repeated subfields.

$^U_S$   Unit separator character – separates information items.

The $^G_S$ is used between fields – the $^F_S$ between logical records:

$$\mathbf{FN_j: IF}\ {}^{G}_{S}\ \mathbf{FN_k: \dots}\ {}^{F}_{S}\ \mathbf{FN_1: IF}\ {}^{G}_{S}\ \mathbf{\dots}\ {}^{F}_{S}$$

For fields with more than one information item, the ${}^{U}_{S}$ is used:

$$\mathbf{FN_j: II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{G}_{S}\ \mathbf{FN_k \dots}\ {}^{F}_{S}$$

For fields with multiple subfields, the ${}^{R}_{S}$ is used:

$$\mathbf{FN_j: II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{R}_{S}\ \mathbf{II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{G}_{S}\ \mathbf{FN_k \dots}\ {}^{F}_{S}$$

which are expressed as:

$$\mathbf{FN_j: SF_1}\ {}^{R}_{S}\ \mathbf{SF_2}\ {}^{G}_{S}\ \mathbf{FN_k \dots}\ {}^{F}_{S}$$

Normally, there should be no empty fields or information items and therefore only one separator character should appear between any two data items. The exception to this rule occurs for those instances where the data in fields or information items in a transaction are unavailable, missing, or optional, and the processing of the transaction is not dependent upon the presence of that particular data. In those instances, multiple and adjacent separator characters shall appear together rather than requiring the insertion of dummy data between separator characters.

Consider the definition of a field that consists of three information items. If the information for the second information item is missing, then two adjacent "$U_S$" information separator characters would occur between the first and third information items. If the second and third information items were both missing, then three separator characters should be used – two "$U_S$" characters in addition to the terminating field or subfield separator character. In general, if one or more mandatory or optional information items are unavailable for a field or subfield, then the appropriate number of separator character should be inserted.

It is possible to have side-by-side combinations of two or more of the four available separator characters. When data are missing or unavailable for information items, subfields, or fields, there shall be one fewer separator characters present than the number of data items, subfields, or fields required.

## Transmitted data conventions

### Byte and bit ordering

Each information item, subfield, field, and logical record shall contain one or more bytes of data. Within a file, the order for transmission of both the ASCII and the binary representations of bytes shall be most significant byte first and least significant byte last otherwise referred to as Big-Endian format. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last. **Figure 15** illustrates the order of transmission of the bytes and bits within a file.
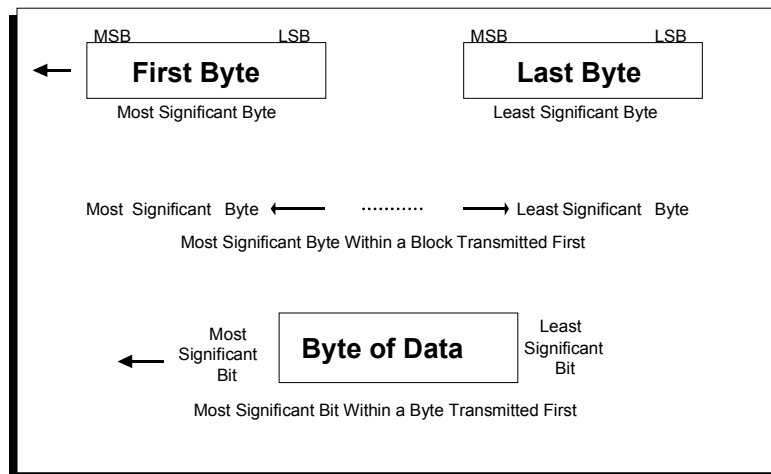


**Figure 15 Byte and bit ordering**

### Date format

Dates shall appear as eight digits in the format YYYYMMDD. The YYYY characters shall represent the year of the transaction; the MM characters shall be the tens and units values of the month; and the DD characters shall be the day in the month. For example, "20070103" represents January 3, 2007.

**Agency Codes**

The 2007 version of the standard included only the first information item in agency code fields (See **Clause 7.16).** New to this version, a second, optional, information item is allowed in Traditional encoding in order to maintain consistency with the 2008 version of the standard. For the example of **Field 1.008 Originating agency identifier / ORG** an example might be:

"1.013:NY0303000SLAS1000$^U_S$Text Goes Here$^U_S$$^G_S$"

**GMT/UTC Date/Time format**

GMT/UTC shall be represented as YYYYMMDDHHMMSSZ, a 15-character string that is the concatenation of the date with the time and concludes with the character "Z". The YYYY characters shall represent the year of the transaction. The MM characters shall be the tens and units values of the month. The DD characters shall be the tens and units values of the day of the month. The HH characters represent the hour; the MM the minute; and the SS represents the second. The complete date shall not exceed the current date.

**Record layout**

For the Type-1, Type-2, Type-9 through Type-99 records, each information field that is used shall be numbered in accordance with this standard. The format for each field shall consist of the logical record type number followed by a period ".", a field number followed by a colon ":", followed by the information appropriate to that field. The field number may be any one to nine-digit number occurring between the period "." and the colon ":". It shall be interpreted as an unsigned integer field number. This implies that a field number of "2.123:" is equivalent to and shall be interpreted in the same manner as a field number of "2.000000123:".

For purposes of illustration throughout this annex, a three-digit number shall be used for enumerating the fields contained in each of the Record Types, other than 4, 7 and 8. Field numbers will have the form of "TT.xxx:" where the "TT" represents the one- or two-character record type followed by a period. The next three characters comprise the appropriate field number followed by a colon. Descriptive ASCII information or the sample data follows the colon.

Logical Type-1, Type-2, and Type-9 records contain only ASCII textual data fields. The entire length of the record (including field numbers, colons, and information separators) shall be recorded as the first ASCII field within each of these record types. The ASCII File Separator "$^F_S$" control character (signifying the end of the logical record or transaction) shall follow the last byte of ASCII information and shall be included in the length of the record.

The Type-4 and Type-8 records contain only binary data recorded as ordered fixed-length binary fields. The entire length of the record shall be recorded in the first four-byte binary field of each record. For these binary records, neither the record number with its period, nor the field identifier number and its following colon, shall be recorded. Furthermore, as all the field lengths of these six records are either fixed and specified, none of the four separator characters ("$^U_S$", "$^R_S$", "$^G_S$", or "$^F_S$") shall be interpreted as anything other than binary data. For these binary records, the "$^F_S$" character shall not be used as a record separator or transaction terminating character.

The Type-10 through Type-99 records combine ASCII fields with a single binary sample field. Each ASCII field contains a numeric field identifier and its descriptive data. When Field 999 is present in a record, it shall appear as the last entry in the record and shall contain the data placed immediately following the colon (":") of the field identifier. The record length field shall contain the length of the record. The ASCII File Separator "$^F_S$" control character shall follow the last byte of the compressed or uncompressed sample data. The "$^F_S$" character shall signify the end of the logical record or transaction and shall be included as part of the record length.

The Base-64 encoding scheme shall be used for converting non-ASCII text into ASCII form. By convention, any language or character set text string following the Start-of-Text character sequence will be Base-64 encoded for subsequent processing. The field number including the period and colon, for example "2.001:", in addition to the "$^U_S$", "$^R_S$", "$^G_S$", and "$^F_S$" information separators shall appear in the transaction as 7-bit ASCII characters without conversion to Base-64 encoding.

**Switching between character encoding sets**

All of the fields in the Type-1 transaction record shall be recorded using the 7-bit ASCII code, which is the default character encoding set code within a transaction. In order to affect data and transaction interchanges between non-English speaking or foreign-based agencies, a technique is available to encode information using character encoding sets other than 7-bit ASCII. Fields from the Type-1 logical record and ASCII "LEN" and "IDC" text fields shall still be encoded using 7-bit ASCII, but all other designated text fields may be encoded using alternate character encoding sets. The general mechanism for accomplishing this provides for backward compatibility with existing readers, supports multiple character encoding sets in a single text string, and handles internationally accepted character encoding sets and text order conventions such as UTF-8, UTF-16BE and UTF-32.

To switch character encoding sets within a transaction, the Type-1 record shall contain a field listing the Directory of Character Encoding Sets (DCS) used in the transaction. The DCS is an ordered list of triples, each consisting of 3 information items containing an identifying code, the name of an international character encoding set, and its version. The code for a specific character encoding set and other special codes shall be embedded in the transaction to signal the conversion to a different international character encoding set. The ASCII Start-of-Text "$_{STX}$" character (0x02) followed by the equal sign "=" is used to signal the change to an alternate character encoding set defined by the specific DCS code that follows. The entire Start-of-Text sequence is terminated by a single instance of the ASCII End-of-Text "$_{ETX}$" character (0x03). This alternate character encoding set will remain active until a closing "$_{ETX}$" character is encountered or the next ASCII information separator character is encountered. All text between the STX sequence and the closing ETX character shall be encoded in Base-64 notation. This is true even when the 7-bit ASCII character encoding set is specified.

Alternate character encoding sets are allowed as an alternative to the technique that requires the usage of the ASCII "$_{STX}$" and "$_{ETX}$" characters to signify the beginning or end of international characters. Alternate character encoding sets shall only be used in user-defined fields and text fields, such as **Comment / COM** in Record Types 9 and above. Even though there is no overlap within the character encoding sets used with UTF-8, it should be registered in the Type-1 record within **Field 1.015 Directory of character encoding sets / DCS.**

**Base-64 encoding scheme**

The Base-64 Content-Transfer-Encoding is designed to represent arbitrary sequences of octets in a form that need not be humanly readable. The encoding and decoding algorithms are simple, but the encoded data are consistently only about 33 percent larger than the uuencoded[288] data. This encoding is virtually identical to the one used in Privacy Enhanced Mail (PEM) applications, as defined in *RFC 1421*[289]. The Base-64 encoding is adapted from *RFC 1421*, with one change: base-64 eliminates the "*" mechanism for embedded clear text.

A 65-character subset of US-ASCII is used, enabling 6 bits to be represented per printable character. (The extra 65th character, "=", is used to signify a special processing function.)

This subset has the important property that it is represented identically in all versions of *ISO 646*, including US ASCII and all characters in the subset are also represented identically in all versions of EBCDIC.  Other popular encodings, such as the encoding used by the uuencode utility and the Base-85 encoding specified as part of Level 2 PostScript, do not share these properties, and thus do not fulfill the portability requirements a binary transport encoding for mail shall meet.

The encoding process represents 24-bit groups of input bits as output strings of 4 encoded characters. Proceeding from left to right, concatenating three 8-bit input groups forms a 24-bit input group. These 24 bits are then treated as four concatenated 6-bit groups, each of which is translated into a single digit in the Base-64 alphabet. When encoding a bit stream via the Base-64 encoding, the bit stream shall be presumed to be ordered with the most significant bit first. That is, the first bit in the stream will be the high-order bit in the first byte, and the eighth bit will be the low-order bit in the first byte, and so on.

Each 6-bit group is used as an index into an array of 64 printable characters. The character referenced by the index is placed in the output string. These characters, identified in **Table 96**, below, are selected so as to be universally representable, and the set excludes characters with particular significance to SMTP (e.g., ".", CR, LF) and to the encapsulation boundaries defined in this document (e.g., "-").

The output stream (encoded bytes) shall be represented in lines of no more than 76 characters each. All line breaks or other characters not found in **Table 96** shall be ignored by decoding software. In base-64 data, characters other than those in **Table 96**, line

---

[288] uuencode is a character encoding that was originally developed for UNIX.

[289] RFC 1421 – Privacy Enhancement for Internet Electron Mail, available at :
http://www.faqs.org/rfcs/rfc1421.html

breaks, and other white space probably indicate a transmission error, about which a warning message or even a message rejection might be appropriate under some circumstances.

**Table 96 Base-64 alphabet**

| Value | Encoding | Value | Encoding | Value | Encoding | Value | Encoding |
|---|---|---|---|---|---|---|---|
| 0 | A | 17 | R | 34 | I | 51 | z |
| 1 | B | 18 | S | 35 | j | 52 | 0 |
| 2 | C | 19 | T | 36 | k | 53 | 1 |
| 3 | D | 20 | U | 37 | l | 54 | 2 |
| 4 | E | 21 | V | 38 | m | 55 | 3 |
| 5 | F | 22 | W | 39 | n | 56 | 4 |
| 6 | G | 23 | X | 40 | o | 57 | 5 |
| 7 | H | 24 | Y | 41 | p | 58 | 6 |
| 8 | I | 25 | Z | 42 | q | 59 | 7 |
| 9 | J | 26 | a | 43 | r | 60 | 8 |
| 10 | K | 27 | b | 44 | s | 61 | 9 |
| 11 | L | 28 | c | 45 | t | 62 | + |
| 12 | M | 29 | d | 46 | u | 63 | / |
| 13 | N | 30 | e | 47 | v | | |
| 14 | O | 31 | f | 48 | w | (pad) | = |
| 15 | P | 32 | g | 49 | x | | |
| 16 | Q | 33 | h | 50 | y | | |

Special processing is performed if fewer than 24 bits are available at the end of the data being encoded. A full encoding quantum is always completed at the end of a body. When fewer than 24 input bits are available in an input group, zero bits are added (on the right) to form an integral number of 6-bit groups. Padding at the end of the data is performed using the '=' character. Since all base-64 input is an integral number of octets, only the following cases can arise: (1) the final quantum of encoding input is an integral multiple of 24 bits; here, the final unit of encoded output will be an integral multiple of four characters with no "=" padding, (2) the final quantum of encoding input is exactly 8 bits; here, the final unit of encoded output will be two characters followed by two "=" padding characters, or (3) the final quantum of encoding input is exactly 16 bits; here, the final unit of encoded output will be three characters followed by one "=" padding character.

Because it is used only for padding at the end of the data, the occurrence of any '=' characters may be taken as evidence that the end of the data has been reached (without truncation in transit). No such assurance is possible, however, when the number of octets

transmitted was a multiple of three.

Any characters outside of the Base-64 alphabet are to be ignored in Base-64-encoded data. The same applies to any illegal sequence of characters in the Base-64 encoding, such as "=====".Care shall be taken to use the proper octets for line breaks if Base-64 encoding is applied directly to text material that has not been converted to canonical form. In particular, text line breaks shall be converted into CRLF sequences prior to Base-64 encoding. The important thing to note is that this may be done directly by the encoder rather than in a prior cannibalization step in some implementations.

NOTE: There is no need to worry about quoting apparent encapsulation boundaries within Base-64-encoded parts of multipart because no hyphen characters are used in the Base-64 encoding.

**Encoding for specific record types**

## Type-1 record

**Field 1.001 Record header** shall begin with "1.001:" followed by the length of the record including every character of every field contained in the record and the information separators. The "$^{G}_{S}$" separator character shall separate the length code of **Field 1.001** from the next field.

The year, month, and day values in **Field 1.005 Date / DAT** are concatenated "YYYYMMDD". The complete date shall be a legitimate date.

In Field 1.013**,** the default is
"1.103:NORAM$^{U}_{S}$TexasDPS$^{U}_{S}$$^{G}_{S}$"

Immediately following the last information item in the Type-1 record (See **Clause 8.1**), an "$^{F}_{S}$" separator character shall be used to separate it from the next logical record. This "$^{F}_{S}$" character shall replace the "GS" character that is normally used between information fields. This is the case with all Record Types.

# Type-4 record

**Table 97** provides a list of the fields for the Type-4 logical record (See **Clause 8.4**).  The order of fields for Type-4 records is fixed.  All fields and data in this record type shall be recorded as binary information.

Type-4 shall be used for existing systems only.  New applications shall use Record Type-14 (See **Clause 8.14**).

**Table 97 Type 4 record layout**

| Field Number | Tag | Field Description | Byte Count | Byte Position |
|---|---|---|---|---|
| 1 | LEN | LOGICAL RECORD LENGTH | 4 | 1-4 |
| 2 | IDC | INFORMATION DESIGNATION CHARACTER | 1 | 5 |
| 3 | IMP | IMPRESSION TYPE | 1 | 6 |
| 4 | FGP | FINGER POSITION | 6 | 7-12 |
| 5 | ISR | IMAGE SCANNING RESOLUTION | 1 | 13 |
| 6 | HLL | HORIZONTAL LINE LENGTH | 2 | 14-15 |
| 7 | VLL | VERTICAL LINE LENGTH | 2 | 16-17 |
| 8 | GCA / BCA | COMPRESSION ALGORITHM | 1 | 18 |
| 9 | DATA | IMAGE DATA | <LEN> – 18 | 19 through <LEN> |

## Type-7 record

With the exception of the first two fields, the order of the remaining fields of the Type-7 record (See **Clause 8.7**) is user-defined. All fields and data in Type-7 records shall be recorded as binary information.

Type-7 shall be used for existing systems only. New applications shall use Record Type-13 (See **Clause 8.13**) for latent prints and Record Type-16 (See **Clause 8.16**) for test images.

The first two fields are fixed length and total five bytes. These fields shall precede one or more user-defined fields, including the image data, contained in the remainder of the record.

### Logical record length / LEN

This mandatory four-byte binary field (**Field 7.001: Record header**) shall occupy bytes one through four. It shall contain the length of the logical record specifying the total number of bytes, including every byte of all the fields contained in the record.

### Information designation character / IDC

This mandatory one-byte binary field (**Field 7.002: Image designation character / IDC**) shall occupy the fifth byte of a Type-7 record. It shall be used to identify the image data contained in this record. The IDC contained in this field shall be a binary representation of the IDC found in **Field 1.003 Transaction content / CNT**.

### User-defined fields for Type-7 records

The remaining fields (**Clause 8.7.3**) of the Type-7 logical record shall be user-defined. Individual fields required for a given transaction, such as field description, size, and content shall conform to the specifications set forth by the agency to whom the transmission is being sent.

### End of Type-7 record

Since the Type-7 logical record is a defined and specified series of binary data fields, no additional bytes shall be transmitted to signify the end of this logical record type.

## Type-8 record

**Table 98** provides a list of the fields for the Type-8 logical record (See **Clause 8.8**).  The order of fields for Type-8 records is fixed.  All fields and data in Type-8 records shall be records as binary information.

### Table 98 Type-8 record layout

| Field Number | Tag | Field Description | Byte Count | Byte Position |
|---|---|---|---|---|
| 1 | LEN | LOGICAL RECORD LENGTH | 4 | 1-4 |
| 2 | IDC | INFORMATION DESIGNATION CHARACTER | 1 | 5 |
| 3 | SIG | SIGNATURE TYPE | 1 | 6 |
| 4 | SRT | SIGNATURE REPRESENTATION TYPE | 1 | 7 |
| 5 | ISR | IMAGE SCANNING RESOLUTION | 1 | 8 |
| 6 | HLL | HORIZONTAL LINE LENGTH | 2 | 9-10 |
| 7 | VLL | VERTICAL LINE LENGTH | 2 | 11-12 |
| 8 | DATA | SIGNATURE IMAGE DATA | <LEN> – 12 | 13 through <LEN> |

## Type-9 record

If legacy fields 9.005 through 9.012 are contained in the transaction, the user should refer to *ANSI/NIST-ITL 1-2007* for encoding details.

## Type-10 record

For facial feature points (**Field 10.029: 2D Facial feature points / FFP** ), the first information item (always "1") is followed by the "$^U_S$" separator character. The second information item is feature point code, followed by "$^U_S$".  The third is the X coordinate,

followed by "$^U$$_S$".  The fourth item is the Y coordinate.  Each feature block shall be separated by the "$^R$$_S$" separator character.  An example transaction that represents two feature points of eye centers is "10.029:1 $^U$$_S$ 12.2 $^U$$_S$ 120 $^U$$_S$ 130 $^R$$_S$ 1 $^U$$_S$ 12.1 $^U$$_S$ 240 $^U$$_S$ 129 $^G$$_S$"

## Type-13 record

For **Field 13.014: Search position descriptors / SPD**, multiple portions of the EJI may be listed and separated by the "$^R$$_S$" separator character.

For Field **Field 13.015: Print position coordinates / PPC**, the six information items within the field are separated by five "$^U$$_S$" separators; individual full finger or segment definitions may be repeated as subfields separated by the "$^R$$_S$" separator.

Field **Field 13.024: Latent quality metric / LQM** may contain one or more subfields, each consisting of four information items separated by the "$^U$$_S$" character.  The subfield may be repeated for each latent image and quality algorithm used, separated by the "$^R$$_S$" character.

## Types-14 through 99 record

There are no special requirements for these record types.

## Annex C NIEM-conformant encoding rules

### Normative

**Introduction**

The document that follows contains a set of requirements for encoding the 2011 ANSI/NIST-ITL standard using Extensible Markup Language (XML).  This document and its references carry forward and improve the description of XML encoding found in *ANSI/NIST-ITL 2-2008*, and extend the encoding specification to include additions to the 2011 base standard.

Where possible, this document follows the outline of the base standard, supplementing sections with information needed by XML implementers.  This document itemizes,

references, and points to additional material such as XML schema, instance examples, transformation data, and a cross-reference to traditional encoding. This document specifies whether referenced material is normative or informative.

Many data interchange and processing applications have converted to or are in the process of migrating toward an XML format approach for processing data. In order to provide the ability to directly interface with such applications, this XML encoding representation of the textual, image, and other biometric information has been developed. This is an XML alternative to the "traditional" encoding format. Implementers will find that, with very few exceptions, there is a "one-to-one" correspondence of XML elements to the elements of the base specification, and to the numerically tagged (or untagged binary) traditional elements described in the **Annex B Traditional encoding**. The repeating subfield and information items (separated by the $^R_S$ and $^U_S$ characters in the traditional representation) have been given named XML counterparts.

The XML encoding rules and referenced materials conform to the National Information Exchange Model (NIEM), which facilitates interoperability for information sharing among multiple government agencies. The XML encoding rules include rules for how user-defined extensions may be included inside the standard XML package, but do not define how the package may be wrapped in other XML structures, like the Logical Entity eXchange Specification (LEXS)[290].

### Changes in the XML encoding for this version of the Standard from 2008

1) The schema document ansi-nist.xsd, in the namespace http://niem.gov/niem/ansi-nist/2.0, is not used by this version of the standard. All necessary elements in ansi-nist.xsd have been replaced by equivalent elements in a biometric domain, in the namespace http://niem.gov/niem/biometrics/1.0, recognized by NIEM.

2) XML elements have been created for all of the new features of version 2011, such as new records for DNA and plantars, and new elements for extended feature set latent encoding and other new fields and information items.

3) XML elements have been removed for features deprecated in version 2011, such as record Types 3, 5, and 6, and elements in record Type-10.

4) To the extent possible, element names and structure have been retained from version 2-2008. Nevertheless, some changes were necessary to improve

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[290] LEXS is a NIEM-based framework for the development of information exchanges. It was originally developed at the US Department of Justice. See http://www.lex.gov

conformance with NIEM, or to repair errors.  A list of these changes is found in the "transformation data" referenced document.

5) Additional constraints have been added to the schema to increase the degree to which XML schema validation will test conformance to the base specification, such as enforcing the maximum length of text strings.

6) The NIEM files contained in the Interface Exchange Package Documentation (IEPD) are a subset of NIEM, containing only those elements used by the standard.

## Scope, purpose, and conformance

There are "user-defined" elements that implementers may create to extend this specification so that it is useful in a particular application.

For XML encoding, these "user-defined" elements have been created in the schema as abstract elements.  Implementers may extend this standard by supplying substitution elements for these abstract elements:

<itl:UserDefinedDetail>,

<itl:RecordImage>,

<itl:RecordMinutiae>,

<itl:DomainDefinedDescriptiveDetail>, and/or

<itl:OtherDescriptiveDetail>.

The implementer's substitution elements shall be created in a separate, user-declared namespace.  The content of the substitution elements shall be well-formed XML and shall follow NIEM rules for using or extending the National Information Exchange Model.

Implementers may modify or add namespace declarations and import elements to reference user-defined namespaces and extension schemas.  The NIEM subset versions of biom.xsd, niem-core.xsd, and other NIEM schemas may be re-subsetted to facilitate use of these elements in user-defined blocks.

Implementers shall not introduce new elements inside the <itl:NISTBiometricInformationExchangePackage> complex except for the substitution elements described above.  They shall not change the order or structure of elements defined by the standard.

The root element, <itl:NISTBiometricInformationExchangePackage>, may be included as a payload in a larger package.

All of the base standard's required elements shall be present in a conforming instance document even if the schema referenced by this document do not strictly enforce the requirement.

## Transmitted Data Conventions

### Character encoding set

Each XML information element, tags and data content, shall be represented by a character set that is a subset of Unicode (*ISO/IEC 10646*) and that is allowable by W3C XML. For compatibility with existing implementations of the standard, implementers may wish to limit content to the 128 characters that are represented by 7-bit ASCII. Nevertheless, senders and receivers of XML packages using this standard may agree on other character encoding sets, including international and special character sets.

### Unicode

Characters in all encodings shall be transmitted using Unicode. These Unicode encoding formats are allowable: UTF-8, UTF-16BE, or UTF-32. Use of UTF-8 is encouraged. Senders and receivers of XML packages using this standard shall agree on an encoding format. XML packages shall include an XML declaration that includes an encoding declaration, as in this example:

    <?xml version="1.0" encoding="UTF-8">

### Byte and bit ordering

The order for transmission of the bytes shall be most significant byte first and least significant byte last. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last.

### Grayscale data

Binary data so constructed as to represent a grayscale image shall be converted to 7-bit ASCII characters prior to transmission using Base-64 encoding.

### Binary data

Binary image data may be constructed in either compressed or uncompressed form, then shall be converted to 7-bit ASCII characters prior to transmission using Base-64

encoding. Binary data fields, other than image data, in the Type-4, 7, and 8 records have been given conventional XML element tags. For XML encoding, these data elements and their content shall be represented as 7-bit ASCII characters.

## Data Conventions Specific to XML

### Record Format

An exchange package shall consist of one or more logical records. For each logical record contained in the package, several information elements appropriate to that record type shall be present. Complex elements may contain one or more complex or simple elements according to the rules of well-formed XML. Taken together, these items are used to convey different aspects of the data contained in a data information object. To the extent possible, the objects used have been defined as a part of the National Information Exchange Model (NIEM). Some information objects may be repeated multiple times.

The XML schema referenced for this encoding define the structure and order of the elements in the information exchange package. To the extent possible, the schema define data types and constraints that enforce the allowable content rules of the base standard. Nevertheless, the XML schema may not strictly enforce the allowable content. The base standard defines allowable content, and its requirements shall be met by implementers regardless of encoding method.

### Information Separators

All separators are defined by the W3C XML recommendations. The characters "<" and ">" are reserved exclusively for enclosing XML element names. Every element with a start tag <Name> shall have an end tag of format </Name>.

### Record layout

For all logical records – including Types 4, 7, and 8 that do not have field tags in the traditional encoding -- data elements are tagged according to XML rules. The format for each element shall consist of a start tag enclosed in angle brackets followed by data followed by an end tag. For example <nc:IdentificationID>6</nc:IdentificationID>.

Complex data elements contain other elements in a nested fashion; for example

```
<biom:ImageReferenceIdentification>
      <nc:IdentificationID>6</nc:IdentificationID>
</biom:ImageReferenceIdentification>
```

The ordering of elements is strict. The schema referenced by this document define the order and nesting structure of elements. The schema also provide a W3C representation of the order and hierarchical structure of the XML content.

**Date Format**

Common dates (other than GMT) shall be represented in the form YYYY-MM-DD, YYYY-MM, or YYYY. Examples

```
<itl:TransactionDate>
        <nc:Date>2008-02-29</nc:Date>
</itl:TransactionDate>

<itl:TransactionDate>
        <nc:YearMonth>2008-02</nc:YearMonth>
</itl:TransactionDate>

<itl:TransactionDate>
        <nc:Year>2008</nc:Year>
</itl:TransactionDate>
```

**GMT Date/Time Format**

GMT date/time values shall be represented in the form YYYY-MM-DDThh:mm:ssZ. For example

```
<itl:TransactionUTCDate>
        <nc:DateTime>2008-02-29T05:25:00Z</nc:DateTime>
</itl:TransactionUTCDate>
```

**Allowable use of Organization Name**

Implementers may include an optional text value for the name of an organization in addition to its identifier. For example

```
<itl:TransactionDestinationOrganization>
        <nc:OrganizationIdentification>
                <nc:IdentificationID>WI013415Y</nc:IdentificationID>
        </nc:OrganizationIdentification>
        <nc:OrganizationName>WI Crime Bureau</nc:OrganizationName>
</itl:TransactionDestinationOrganization>
```

**Abstract Elements**

Abstract elements are present wherever implementers are allowed to extend the specification by adding additional elements of their own design. A single example here will be illustrative. The complex element <itl:DomainDefinedDescriptiveDetail> is abstract, and as such is unusable by itself. Implementers shall define, in an extension schema, a substitution element containing user-defined child elements.

A substitution element should be defined in a user's extension schema similar to this:

```
<xsd:element name="DomainDefinedDescriptiveDetail"
        substitutionGroup="itl:DomainDefinedDescriptiveDetail"
        type="user-namespace:DomainDefinedDescriptiveDetailType"/>
<xsd:complexType name="DomainDefinedDescriptiveDetailType">
        <xsd:complexContent>
                <xsd:extension base="s:ComplexObjectType">
                        <xsd:sequence>
                                <xsd:element ref="user-namespace:OneField"/>
                                <xsd:element ref="user-namespace:TwoField"/>
                        </xsd:sequence>
                </xsd:extension>
        </xsd:complexContent>
</xsd:complexType>
```

The substitution element would then appear in an instance document like this:

```
<user-namespace:DomainDefinedDescriptiveDetail>
        <user-namespace:OneField>Text</user-namespace:OneField>
        <user-namespace:TwoField>Text</user-namespace:TwoField>
</user-namespace:DomainDefinedDescriptiveDetail>
```

**Record Length**

There is no corresponding XML element. See **Clause 7.1.**

**Image Data**

Image data shall be converted to ASCII characters using the Base-64 encoding algorithm. (See **Clause 7.8**)

<nc:BinaryBase64Object>**mrHbPdrko3u1s7ahtgPBjtmO1s85tfG2U7bpofY9 4Czu2SbY7d7wF9fQ7ZptgGrtkO2a2dsJ7wZbe 8BlzvAmQ7xq+Y94GoHeEsR3ikWd4DIGhzmp3k42 d4DRmzs94DKveDTB3hqw6PeBLrtpPep0H/+h**</nc:BinaryBase64Object>

**Guidance on Missing Data for Mandatory and Optional Elements**

If the base specification and schema define an element as optional, it should be omitted altogether rather than transmitting the element tags without any data content.

For mandatory elements, in all cases, the element tags shall appear in the instance package. When there is no information to be transmitted for a mandatory element, prior agreement shall be made with the recipient agency or organization before constructing and transmitting an instance package. For cases where an agreement is made to accept records with missing mandatory data, the following recommendations are made.

**Missing Mandatory String Element Data (nc:TextType)**

The content of certain elements (such as agency identifiers or types of transaction) is left to users to define. For example, it is stated in this standard that the content of the element <biom:CaptureOrganization> (or Source agency/ORI) "shall be defined by the user and be in accordance with the receiving agency." The sender and receiver may choose to establish an identifier for missing information. In this case, the preferred representation for missing data is to use the value "UNKNOWN" (provided that there is no other option available).

<biom:CaptureOrganization>UNKNOWN
</biom:CaptureOrganization>

**Missing Mandatory Date Element Data (nc:Date)**

Due to NIEM rules for date elements, the preferred representation for missing date data is to "nil" the parent element, as shown in this example:

```
<biom:CaptureDate xsi:nil="true"/>
```

Partially missing date data may be represented as follows:

```
<biom:CaptureDate>
      <nc:Year>1995</nc:Year>
</biom:CaptureDate>
or
<biom:CaptureDate>
      <nc:YearMonth>1995-05</nc:YearMonth>
</biom:CaptureDate>
```

**Information Exchange Package Description**

The base standard defines the composition of a transmission. For XML encoding, this is the complex <itl:NISTBiometricInformationExchangePackage> and its contents. In many cases, the package will be included as a payload with an XML-formatted outer wrapper for transaction or protocol purposes. The package may also be a part of a larger, user-defined data structure. This standard strictly defines, however, the content of data within the <itl:NISTBiometricInformationExchangePackage> complex element.

Certain portions of the exchange package shall be in accordance with definitions provided by the receiving agency. This exchange package shall contain one or more logical records each corresponding to one of the defined available types. The logical records are intended to convey specific types of related information pertinent to the exchange package itself or to the subject of the package. All of the logical records belonging to a single package shall be contained within a single <itl:NISTBiometricInformationExchangePackage> element. For XML encoding, all data is expressed as ASCII, with ASCII XML element tags. All binary image data is converted to ASCII using Base-64 encoding.

**Table 99 Record element tags for the record types**

| Record Category Code | Record Element Tag | Logical record contents |
|---|---|---|
| 1 | <itl:PackageInformationRecord> | Transaction information |
| 2 | <itl:PackageDescriptiveTextRecord> | User-defined descriptive text |
| 3 | | **deprecated** |
| 4 | <itl:PackageHighResolutionGrayscaleImageRecord> | High-resolution grayscale fingerprint image |
| 5 | | **deprecated** |
| 6 | | **deprecated** |
| 7 | <itl:PackageUserDefinedImageRecord> | User-defined image |
| 8 | <itl:PackageSignatureImageRecord> | Signature image |
| 9 | <itl:PackageMinutiaeRecord> | Minutiae data |
| 10 | <itl:PackageFacialAndSMTImageRecord> | Facial & SMT image |
| 11 | | Reserved for voice |
| 12 | | Reserved for dental |
| 13 | <itl:PackageLatentImageRecord> | Variable-resolution latent image |
| 14 | <itl:PackageFingerprintImageRecord> | Variable-resolution fingerprint image |
| 15 | <itl:PackagePalmprintImageRecord> | Variable-resolution palmprint Image |
| 16 | <itl:PackageUserDefinedTestingImageRecord> | User-defined variable-resolution testing Image |
| 17 | <itl:PackageIrisImageRecord> | Iris image |
| 18 | <itl:PackageDNARecord> | DNA data or image |
| 19 | <itl:PackagePlantarImageRecord> | Plantar image |
| 20 | <itl:PackageSourceRepresentationRecord> | Source representation |
| 21 | <itl:PackageAssociatedContextRecord> | Associated context |
| 22-97 | | Reserved for future use |
| 98 | <itl:PackageInformationAssuranceRecord> | Information assurance |
| 99 | <itl:PackageCBEFFBiometricDataRecord> | CBEFF Biometric data |

**Information exchange package format, and record "header"**

The traditional-encoding data field element logical record length has been omitted from the XML encoding specification; there is no technical need for the byte count, and the value would be incompatible and meaningless for transformations between traditional and XML packages.

The first element in all XML encoded records shall be labeled <itl:RecordCategoryCode> and contain the type (category) number of the record. (See **Clause 8.2.1)**

The second element in every record other than the Type-1 record, shall be labeled <itl:ImageReferenceIdentification> and contain the **Information designation character / IDC** as described in **Clause 7.2**.

The remaining XML elements in each record shall be present in the order defined by the schema and contain data described in the base standard for that particular element. Elements in the biometric domain and the ITL schema that are new for 2011 have been given an order that corresponds to the base standard as much as possible. Elements in the biometric domain and the ITL schema that are replacements for 2008 elements in ansi-nist.xsd retain their previous order. Note that the order of the elements for XML encoding are mandatory, unlike the order of fields in traditional encoding.

**Implementation domains**

The Type-2 record (See **Clause 8.2**) is composed of user-defined content. Much of the content in the Type-2 record is used in the same way by local, state, and Federal agencies and requires the same data and formatting. In order to establish a common basis for XML elements, meaning, and formatting, jurisdictions that use the same general set of data may subscribe to a common implementation domain.

An implementation domain is a group of agencies or organizations that have agreed to use specific pre-assigned data blocks for exchanging information unique to their installations. Each user-defined XML element shall also have a definition and data type associated with it. Each domain created shall have a point of contact responsible for keeping the documentation on the content of the user-defined data blocks within their domain. The contact shall serve as a registrar and maintain a repository including documentation for all the common and user-specific Type-2 content contained within the substitution block for <itl:DomainDefinedDescriptiveDetail>. As additional fields are required by specific agencies for their own applications, new XML elements and definitions may be registered and reserved to have a specific meaning. When this occurs, the domain registrar is responsible for registering a single definition for each XML element used by different members of the domain. Additional content in the Type-2 record may be defined as a substitute for <itl:OtherDescriptiveDetail> by agreement of sending and receiving parties.

**NIEM biometrics domain**

The biometrics domain is a part of NIEM. It has its own oversight body, and is subject to NIEM governance. The oversight body for the biometrics domain is the Department of Homeland Security. Although the word 'domain' is used for both 'Implementation domain' and 'Biometric domain', the concepts are not related.

## Record descriptions

### Type-1 Transaction information record

The XML name for the Type-1 record (**Clause 8.1**) is <itl:PackageInformationRecord>, and its <itl:RecordCategoryCode> element shall have a value of "01".

### Type-2 User-defined descriptive text record

The XML name for the Type-2 record (**Clause 8.2**) is <itl:PackageDescriptiveTextRecord>, and its <itl:RecordCategoryCode> element shall have a value of "02".

All other content in the Type-2 record is abstract. To use a Type-2 record, implementers shall declare substitution elements in a user-created namespace.

### Type-3, 5, and 6 fingerprint image records

Deprecated.

### Type-4 fingerprint image record

The XML name for the Type-4 record (**Clause 8.4**) is <itl:PackageHighResolutionGrayscaleImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "04".

Unlike traditional encoding, the elements of the Type-4 record shall have ASCII XML element tags. Unlike traditional encoding (See **Annex B Traditional encoding**), the data values of Type-4 fields shall be expressed as ASCII characters. To be strictly consistent with traditional encoding, the <biom:FingerprintImagePosition> element may have six fixed occurrences of the <biom:FingerprintPositionCode> element.

```
<biom:FingerprintImagePosition>
        <biom:FingerPositionCode>2</biom:FingerPositionCode>
        <biom:FingerPositionCode>3</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
</biom:FingerprintImagePosition>
```

For XML encoding, only a single occurrence of the <biom:FingerprintImagePosition> element is required.

**Type-7 User-defined image record**

The XML name for the Type-7 record (**Clause 8.7**) is <itl:PackageUserDefinedImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "07".

With the exception of the <itl:RecordCategoryCode> and <itl:ImageReferenceIdentification> elements, the parameters, and types of images to be exchanged are undefined by this standard. Implementers will define an XML data block that substitutes for the abstract <itl:RecordImage> element provided by this standard. These required details shall be agreed upon between the sender and recipient.

**Type-8 Signature image record**

The XML name for the Type-8 record (**Clause 8.8)** is <itl:PackageSignatureImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "08".

Unlike traditional encoding, the elements of the Type-8 record have ASCII XML element tags. Unlike traditional encoding, the data values of Type-8 fields shall be expressed as ASCII characters.

For the Type-8 record, implementers may insert a <biom:SignatureImageVectorRepresentation> in place of the <nc:BinaryBase64Object> within the <biom:SignatureImage> complex element.

**Type-9 Minutiae data record**

The XML name for the Type-9 record (**Clause 8.9**) is <itl:PackageMinutiaeRecord>, and its <itl:RecordCategoryCode> element shall have a value of "09".

There are no usable, concrete elements within the <itl:RecordMinutiae> complex. Implementers who wish to use a Type-9 record with other than the INCITS-M1 or EFS blocks shall define and substitute a complex element for <itl:RecordMinutiae>.

**Type-10 Facial, other body part & SMT image record**

The XML name for the Type-10 record (**Clause 8.10**) is <itl:PackageFacialAndSMTImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "10". Within a single Type-10 record, implementers shall choose

between a single <biom:FaceImage> complex element, or a <biom:PhysicalFeatureImage> complex element.

### Type-13 Variable-resolution latent image record

The XML name for the Type-13 record (**Clause 8.13**) is <itl:PackageLatentImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "13".

### Type-14 Variable-resolution fingerprint image record

The XML name for the Type-14 record (**Clause 8.14**) is <itl:PackageFingerprintImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "14".

### Type-15 Variable-resolution palmprint image record

The XML name for the Type-15 record (**Clause 8.15**) is <itl:PackagePalmprintImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "15".

### Type-16 User-defined variable-resolution testing image record

The XML name for the Type-16 record (**Clause 8.16**) is <itl:PackageUserDefinedTestingImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "16".

### Type-17 Iris image record

The XML name for the Type-17 record (**Clause 8.17**) is <itl:PackageIrisImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "17".

### Type-18 DNA record

The XML name for the Type-18 record (**Clause 8.18**) is <itl:PackageDNARecord>, and its <itl:RecordCategoryCode> element shall have a value of "18".

### Type-19 Plantar image record

The XML name for the Type-19 record (**Clause 8.19**) is <itl:PackagePlantarImageRecord>, and its <itl:RecordCategoryCode> element shall have a value of "19".

### Type-20 Source representation record

The XML name for the Type-20 record (**Clause 8.20**) is
<itl:PackageSourceRepresentationRecord>, and its <itl:RecordCategoryCode> element
shall have a value of "20".

### Type-21 Associated context record

The XML name for the Type-21 record (**Clause 8.21**) is
<itl:PackageAssociatedContextRecord>, and its <itl:RecordCategoryCode> element shall
have a value of "21".

### Type-98 Information assurance record

The XML name for the Type-98 record (**Clause 8.22**) is
<itl:PackageInformationAssuranceRecord>, and its <itl:RecordCategoryCode> element
shall have a value of "98".

### Type-99 CBEFF biometric data record

The XML name for the Type-99 record (**Clause 8.10**) is
<itl:PackageCBEFFBiometricDataRecord>, and its <itl:RecordCategoryCode> element
shall have a value of "99".

Implementers should note that the value of the <biom:CaptureDate> element differs in
the Type-99 record from its occurrence in other records.  CBEFF requires both date and
time.  The date and time shall appear as twenty characters in the format YYYY-MM-
DDThh:mm:ssZ.  The YYYY characters shall represent the year; the MM characters shall
be the tens and units values of the month; and the DD characters shall be the tens and
units values of the day of the month; the character T separates the date from the time; the
hh characters represent the hour; the mm the minute; the ss represents the second; and Z
denotes Coordinated Universal Time, which is abbreviated UTC.  The complete date shall
not exceed the UTC value of the current date.

Complex element <biom:CaptureDate> shall have the simple element <nc:DateTime>,
which will contain transaction date and time data.

        <biom:CaptureDate>
                <nc:DateTime>2008-02-29T05:25:00Z</nc:DateTime>
        </biom:CaptureDate>

**Additional information**

The homepage for this standard (http://www.nist.gov/itl/iad/ig/ansi_standard.cfm)
contains the following useful references:
- Instance document(s)
- Narrative description of transformation from 2-2008 to 2011
- XSLT transformation to/from 2-2008
- Cross-reference to ISO 10794 XML elements

The schema for ANSI/NIST-ITL 1-2011 is available at
http://www.nist.gov/itl/iad/ig/ansi_standard.cfm

or at:

http://biometrics.nist.gov/standard/2-2011_

# Annex D NCIC code table

## Normative

This annex contains codes based on portions of the Ninth edition (December, 2000) of the NCIC Code Manual for describing Scars, Marks, Tattoos, and other characteristics (alphabetized by code). The following list is intended to standardize entry of data in the SMT Field. Care must be taken to enter spaces exactly as shown. However, as the NCIC Code Manual gets updated, the latest edition shall be the governing document regarding valid SMT codes.

| Item/Location | Code |
|---|---|
| Arm, nonspecific, artificial | ART ARM |
| Breast, nonspecific, artificial | ART BRST |
| Breast implant, left and right | ART BRSTS |
| Ear, nonspecific, artificial | ART EAR |
| Artificial elbow joint | ART ELB0W |
| Eye, nonspecific, artificial | ART EYE |
| Foot, nonspecific, artificial | ART F00T |
| Hand, nonspecific, artificial | ART HAND |
| Artificial hip joint | ART HIP |
| Artificial knee joint | ART KNEE |
| Arm, left, artificial | ART L ARM |
| Breast implant, left | ART L BRST |
| Ear, left, artificial | ART L EAR |
| Left Elbow, artificial | ART L ELB |
| Eye, left, artificial | ART L EYE |
| Foot, left, artificial | ART L FT |
| Left Hip, artificial | ART L HIP |
| Hand, left, artificial | ART L HND |
| Left Knee, artificial | ART L KNE |
| Leg, left, artificial | ART L LEG |
| Left Shoulder, artificial | ART L SHLD |
| Artificial larynx | ART LARYNX |
| Leg, nonspecific, artificial | ART LEG |
| Arm, right, artificial | ART R ARM |
| Breast implant, right | ART R BRST |
| Ear, right, artificial | ART R EAR |
| Right Elbow, artificial | ART R ELB |
| Eye, right, artificial | ART R EYE |
| Foot, right, artificial | ART R FT |
| Right Hip, artificial | ART R HIP |
| Hand, right, artificial | ART R HND |
| Right Knee, artificial | ART R KNE |
| Leg, right, artificial | ART R LEG |

| Right Shoulder, artificial | ART R SHLD |
|---|---|
| Artificial shoulder joint | ART SHLD |
| Bald/Balding | BALD |
| Blind, both eyes | BLIND |
| Blind, one eye, nonspecific | BLND EYE |
| Blind, left eye | BLND L EYE |
| Blind, right eye | BLND R EYE |
| Brace, left and right arms | BRA LR ARM |
| Brace, left and right legs | BRA LR LEG |
| Brace, one arm, nonspecific | BRAC ARM |
| Brace, left arm | BRAC L ARM |
| Brace, left leg | BRAC L LEG |
| Brace, one leg, nonspecific | BRAC LEG |
| Brace, right arm | BRAC R ARM |
| Brace, right leg | BRAC R LEG |
| Brace, teeth | BRAC TEETH |
| Brace, back | BRACE BACK |
| Brace, neck | BRACE NECK |
| Cane | CANE |
| Cardiac pacemaker | CARD PACEM |
| Cataract, left eye | CATA L EYE |
| Cataract, right eye | CATA R EYE |
| Cataract, (nonspecified) | CATARACT |
| Cauliflower Ear | CAUL EAR |
| Cauliflower ear, left | CAUL L EAR |
| Cauliflower ear, right | CAUL R EAR |
| Cleft Lip | CL LIP |
| Cleft chin | CLEFT CHIN |
| Cleft palate | CLEFT PAL |
| Arm, nonspecific, crippled | CRIP ARM |
| Finger(s), nonspecific, crippled | CRIP FGR |
| Foot, nonspecific, crippled | CRIP F00T |
| Hand, nonspecific, crippled | CRIP HAND |
| Crippled arm, left | CRIP L ARM |

| | | | |
|---|---|---|---|
| Crippled finger(s), left hand (includes webbed fingers) | CRIP L FGR | Deaf, left and right ears | DEAF |
| Crippled foot, left (includes clubfoot) | CRIP L FT | Deaf, one ear (nonspecific) | DEAF EAR |
| Crippled hand, left | CRIP L HND | Deaf, left ear | DEAF L EAR |
| Crippled leg, left | CRIP L LEG | Deaf-mute | DEAF MUTE |
| Crippled toe(s), left (includes webbed toes) | CRIP L T0E | Deaf, right ear | DEAF R EAR |
| | | Denture, lower only | DENT L0W |
| Leg, nonspecific, crippled | CRIP LEG | Denture, upper only | DENT UP |
| Crippled arm, right | CRIP R ARM | Denture, upper and lower | DENT UP L0 |
| Crippled finger(s), right hand (includes webbed fingers) | CRIP R FGR | Deviated septum | DEV SEPTUM |
| | | Cheek, nonspecific, dimple | DIMP CHEEK |
| Crippled foot, right (includes clubfoot) | CRIP R FT | Dimples, chin | DIMP CHIN |
| | | Face, dimple | DIMP FACE |
| Crippled hand, right | CRIP R HND | Dimples, left cheek (face) | DIMP L CHK |
| Crippled leg, right | CRIP R LEG | Dimples, right cheek (face) | DIMP R CHK |
| Crippled toe(s), right (includes webbed toes) | CRIP R T0E | | |
| | | Abdomen | DISC ABD0M |
| Toe(s), nonspecific, crippled | CRIP T0E | Ankle, nonspecific | DISC ANKL |
| | | Arm, nonspecific | DISC ARM |
| Crutches | CRUTCHES | Back | DISC BACK |
| Crosseyed | CR0SSEYED | Breast, nonspecific | DISC BRST |
| Colostomy appliances | C0L0ST APP | Buttocks, nonspecific | DISC BUTTK |
| Contact lenses | C0N LENSES | Calf, nonspecific, discolored | DISC CALF |
| Alcohol | DA ALC0H0L | Cheek (face), nonspecific | DISC CHEEK |
| Amphetamines (includes stimulants, speed, etc.) | DA AMPHETA | Chest | DISC CHEST |
| | | Chin | DISC CHIN |
| | | Ear, nonspecific | DISC EAR |
| Barbiturates | DA BARBITU | Elbow, nonspecific, discolored | DISC ELB0W |
| Cocaine (includes crack) | DA C0CAINE | Eyebrow, nonspecific | DISC EYE |
| Glue | DA GLUE | Forearm, nonspecific, discolored | DISC F ARM |
| Hallucinogens | DA HALLUCI | | |
| Marijuana | DA MARIJUA | Face, nonspecific | DISC FACE |
| Narcotics (includes Heroin,Morphine, Dilaudid, Methadone, etc.) | DA NARC0TI | Finger, nonspecific | DISC FGR |
| | | Forehead | DISC FHD |
| | | Foot, nonspecific | DISC F00T |
| | | Groin, nonspecific, discolored | DISC GR0IN |
| Paint (includes thinner) | DA PAINT | Hand, nonspecific, discolored | DISC HAND |
| Ritalin | DA RITALIN | | |
| Rohypnol (Brand name for Flunitrazepam. Also referred to as "rophies", "roofies", "ruffies", and "roche". | DA R0HYPNL | Head | DISC HEAD |
| | | Hip, nonspecific | DISC HIP |
| | | Knee, nonspecific | DISC KNEE |
| | | Ankle, left | DISC L ANK |
| | | Arm, left | DISC L ARM |
| Other drugs of abuse not listed above, identify in the miscellaneous (MIS) field | DA 0THER | Breast, left | DISC L BRS |
| | | Buttock, left | DISC L BUT |
| | | Left Calf, discolored | DISC L CALF |

| | | | |
|---|---|---|---|
| Cheek (face), left | DISC L CHK | Upper Right Arm, discolored | DISC UR ARM |
| Ear, left | DISC L EAR | Wrist, nonspecific | DISC WRIST |
| Left Elbow, discolored | DISC L ELB | Tubes in ears, left and right | EAR TUBES |
| Eyebrow, left/left eye area | DISC L EYE | Extra breast, nonspecific | EXTR BRST |
| Finger(s), left hand | DISC L FGR | Extra nipple, center | EXTR C NIP |
| Foot, left | DISC L FT | Extra vertebrae, cervical | EXTR C VRT |
| Hip, left | DISC L HIP | Extra breast, center | EXTR CBRST |
| Hand, left | DISC L HND | Finger(s), nonspecific, extra | EXTR FGR |
| Leg, left | DISC L LEG | Extra finger(s), left hand | EXTR L FGR |
| Lip, lower | DISC L LIP | Extra nipple, left | EXTR L NIP |
| Left Toe, discolored | DISC L T0E | EXTRA TOOTH/TEETH (LOWER JAW) | EXTR L TTH |
| Wrist, left | DISC L WRS | Extra toe(s), left | EXTR L T0E |
| Leg, nonspecific | DISC LEG | Extra vertebrae, lumbar | EXTR L VRT |
| Left Forearm, discolored | DISC LF ARM | Extra breast, left | EXTR LBRST |
| Lip, nonspecific | DISC LIP | Extra nipple, nonspecific | EXTR NIP |
| Knee, left | DISC LKNEE | Extra finger(s), right hand | EXTR R FGR |
| Shoulder, left | DISC LSHLD | Extra nipple, right | EXTR R NIP |
| Thigh, left | DISC LTHGH | Extra toe(s), right | EXTR R T0E |
| Neck | DISC NECK | Extra breast, right | EXTR RBRST |
| Nose | DISC N0SE | Tooth/Teeth, nonspecific, extra | EXTR TTH |
| Penis | DISC PENIS | Toe(s), nonspecific, extra | EXTR T0E |
| Ankle, right | DISC R ANK | EXTRA TOOTH/TEETH (UPPER JAW) | EXTR U TTH |
| Arm, right | DISC R ARM | Extra vertebrae, nonspecific | EXTR VRT |
| Breast, right | DISC R BRS | Ankle, nonspecific | FRC ANKL |
| Buttock, right | DISC R BUT | Arm, nonspecific | FRC ARM |
| Right Calf, discolored | DISC R CALF | Back | FRC BACK |
| Cheek (face), right | DISC R CHK | Clavicle, nonspecific | FRC CLAVIC |
| Ear, right | DISC R EAR | Elbow, nonspecific, fractured | FRC ELB0W |
| Right Elbow, discolored | DISC R ELB | Finger(s), nonspecific | FRC FGR |
| Eyebrow, right/right eye area | DISC R EYE | Foot, nonspecific | FRC F00T |
| Finger(s), right hand | DISC R FGR | Hand, nonspecific | FRC HAND |
| Foot, right | DISC R FT | Hip, nonspecific, fractured | FRC HIP |
| Hip, right | DISC R HIP | Jaw, nonspecific | FRC JAW |
| Hand, right | DISC R HND | Knee, nonspecific | FRC KNEE |
| Leg, right | DISC R LEG | Ankle, left | FRC L ANKL |
| Right Toe, discolored | DISC R T0E | Left Arm, fractured | FRC L ARM |
| Wrist, right | DISC R WRS | Left Elbow, fractured | FRC L ELB |
| Right Forearm, discolored | DISC RF ARM | Finger(s), left | FRC L FGR |
| Knee, right | DISC RKNEE | Foot, left | FRC L F00T |
| Shoulder, right | DISC RSHLD | Hand, left | FRC L HAND |
| Thigh, right | DISC RTHGH | Left Hip, fractured | FRC L HIP |
| Shoulder, nonspecific | DISC SHLD | Knee, left | FRC L KNEE |
| Thigh, nonspecific | DISC THGH | | |
| Toe(s), nonspecific, discolored | DISC T0E | | |
| Lip, upper | DISC U LIP | | |
| Upper Left Arm, discolored | DISC UL ARM | | |

| | | | |
|---|---|---|---|
| Left Leg, fractured | FRC L LEG | Hair implants | HAIR IMPL |
| Rib(s), left | FRC L RIB | Hearing Aid | HEAR AID |
| Shoulder, left | FRC L SHLD | Ankle, nonspecific | HFR ANKL |
| Toe(s), left foot | FRC L T0E | Arm, nonspecific | HFR ARM |
| Wrist, left | FRC L WRST | Back | HFR BACK |
| Clavicle, left | FRC LCLAVI | Clavicle, nonspecific | HFR CLAVIC |
| Leg, nonspecific | FRC LEG | Elbow, nonspecific, healed fractured | HFR ELB0W |
| Arm, lower left | FRC LL ARM | | |
| Jaw, lower left | FRC LL JAW | Finger(s), nonspecific | HFR FGR |
| Leg, lower left | FRC LL LEG | Foot, nonspecific | HFR F00T |
| Pelvis bone, left | FRC LPELVI | Hand, nonspecific | HFR HAND |
| Arm, lower right | FRC LR ARM | Hip, nonspecific, healed fractured | HFR HIP |
| Jaw, lower left | FRC LR JAW | | |
| Leg, lower right | FRC LR LEG | Jaw, nonspecific | HFR JAW |
| Neck | FRC NECK | Knee, nonspecific | HFR KNEE |
| Nose | FRC N0SE | Ankle, left | HFR L ANKL |
| Pelvis | FRC PELVIS | Left Arm, healed fractured | HFR L ARM |
| Ankle, right | FRC R ANKL | Left Elbow, healed fractured | HFR L ELB |
| Right Arm, fractured | FRC R ARM | | |
| Right Elbow, fractured | FRC R ELB | Finger(s), left | HFR L FGR |
| Finger(s), right | FRC R FGR | Foot, left | HFR L F00T |
| Foot, right | FRC R F00T | Hand, left | HFR L HAND |
| Hand, right | FRC R HAND | Left Hip, healed fractured | HFR L HIP |
| Right Hip, fractured | FRC R HIP | Knee, left | HFR L KNEE |
| Knee, right | FRC R KNEE | Left Leg, healed fractured | HFR L LEG |
| Right Leg, fractured | FRC R LEG | Rib(s), left | HFR L RIB |
| Rib(s), right | FRC R RIB | Shoulder, left | HFR L SHLD |
| Shoulder, right | FRC R SHLD | Toe(s), left foot | HFR L T0E |
| Toe(s), right foot | FRC R T0E | Wrist, left | HFR L WRST |
| Wrist, right | FRC R WRST | Clavicle, left | HFR LCLAVI |
| Clavicle, right | FRC RCLAVI | Leg, nonspecific | HFR LEG |
| Rib(s), nonspecific | FRC RIBS | Arm, lower left | HFR LL ARM |
| Pelvis bone, right | FRC RPELVI | Jaw, lower left | HFR LL JAW |
| Shoulder, nonspecific | FRC SHLD | Leg, lower left | HFR LL LEG |
| Skull | FRC SKULL | Pelvis bone, left | HFR LPELVI |
| Spine | FRC SPINE | Arm, lower right | HFR LR ARM |
| Sternum | FRC STERN | Jaw, lower left | HFR LR JAW |
| Toe(s), nonspecific | FRC T0E | Leg, lower right | HFR LR LEG |
| Arm, upper left | FRC UL ARM | Neck | HFR NECK |
| Jaw, upper left | FRC UL JAW | Nose | HFR N0SE |
| Leg, upper left | FRC UL LEG | Pelvis | HFR PELVIS |
| Arm, upper right | FRC UR ARM | Ankle, right | HFR R ANKL |
| Jaw, upper right | FRC UR JAW | Right Arm, healed fractured | HFR R ARM |
| Leg, upper right | FRC UR LEG | | |
| Wrist, nonspecific | FRC WRIST | Right Elbow, healed fractured | HFR R ELB |
| Freckles | FRECKLES | | |
| Glasses (prescription) | GLASSES | Finger(s), right | HFR R FGR |
| Glaucoma | GLAUC0MA | Foot, right | HFR R F00T |
| Gold tooth | G0LD T00TH | Hand, right | HFR R HAND |

| | | | |
|---|---|---|---|
| Right Hip, healed fractured | HFR R HIP | Eating Disorders (Includes Anorexia Nervosa and Bulimia) | MC EATDIS |
| Knee, right | HFR R KNEE | Heart or circulatory diseases including: high blood pressure, heart failure, heart attack, hardening of the arteries, and circulation problems | MC HEART |
| Right Leg, healed fractured | HFR R LEG | | |
| Rib(s), right | HFR R RIB | | |
| Shoulder, right | HFR R SHLD | | |
| Toe(s), right foot | HFR R T0E | | |
| Wrist, right | HFR R WRST | | |
| Clavicle, right | HFR RCLAVI | Kidney Conditions or Diseases | MC KIDNEY |
| Rib(s), nonspecific | HFR RIBS | Liver Disease (Including cirrhosis and hepatitis) | MC LIVER |
| Pelvis bone, right | HFR RPELVI | | |
| Shoulder, nonspecific | HFR SHLD | | |
| Skull | HFR SKULL | Nervous conditions including: seizures, stroke, senility, and mental retardation | MC NERV0US |
| Spine | HFR SPINE | | |
| Sternum | HFR STERN | | |
| Toe(s), nonspecific | HFR T0E | | |
| Arm, upper left | HFR UL ARM | Neurological Conditions or Diseases (includes Cerebral Palsy, Epilepsy, Multiple Sclerosis, Parkinson's Disease) | MC NRLGCAL |
| Jaw, upper left | HFR UL JAW | | |
| Leg, upper left | HFR UL LEG | | |
| Arm, upper right | HFR UR ARM | | |
| Jaw, upper right | HFR UR JAW | | |
| Leg, upper right | HFR UR LEG | | |
| Wrist, nonspecific | HFR WRIST | Paraplegic | MC PARPLGC |
| Humpbacked | HUMPBACKED | Pregnancy - Past | MC PASTPRE |
| Penile implant | IMPL PENIS | Pulmonary (Lung) Diseases (includes Emphesyma, Cystic Fibrosis) | MC PLMNARY |
| Intramedullary rod | INTRA R0D | | |
| Intrauterine device | IUD | | |
| Acne | MC ACNE | | |
| Attention Deficit Disorder | MC ADD | Pregnancy - Present | MC PREGNAN |
| Alcoholism | MC ALC0H0L | Quadriplegic | MC QUADPLG |
| Allergies including asthma | MC ALLERGY | Skin Disorders (includes psoriasis and eczema) | MC SKIN |
| Alzheimer's Disease | MC ALZHMRS | | |
| Arthritis | MC ARTHRTS | | |
| Behavior Disorder (includes Autism, Depression, Schizophrenia, Suicidal Tendencies (past and present) | MC BEHAVI0 | Tuberculosis | MC TB |
| | | Thyroid Conditions or Diseases | MC THYR0ID |
| | | Tourette's Syndrome | MC T0URETE |
| | | Other medical disorders/conditions not listed above, identify in the Miscellaneous (MIS) Field | MC 0THER |
| Hematological Diseases (disease of the blood - includes: anemia, hemophilia, leukemia, and sickle cell anemia | MC BL00D | | |
| | | Adenoids | MISS ADND |
| | | Appendix | MISS APPNX |
| Cancer | MC CANCER | Arm, nonspecific, missing | MISS ARM |
| Diabetic | MC DIABTIC | Breast, nonspecific, missing | MISS BRST |
| Drug Abuse | MC DRUGAB | | |
| Down's Syndrome | MC D0WNSYN | Breasts | MISS BRSTS |

| | | | |
|---|---|---|---|
| Missing Cervical Vertebra(e) | MISS C VRT | Kidney, right | MISS R KID |
| Ear, nonspecific, missing | MISS EAR | Leg, right | MISS R LEG |
| Eye, nonspecific, missing | MISS EYE | Testis, right | MISS R TES |
| Finger(s), nonspecific, missing | MISS FGR | Toes(s), right foot | MISS R T0E |
| Finger Joint, nonspecific, missing | MISS FJT | Breast, right | MISS RBRST |
| Foot, nonspecific, missing | MISS F00T | Lung, right | MISS RLUNG |
| Gallbladder | MISS GALL | Ovary, right | MISS R0VAR |
| Hand, nonspecific, missing | MISS HAND | Spleen | MISS SPLEN |
| Intestines | MISS INTES | Stomach | MISS ST0MA |
| Kidney, nonspecific, missing | MISS KID | Testical, nonspecific, missing | MISS TES |
| Arm, left | MISS L ARM | Thyroid | MISS THYRD |
| Ear, left | MISS L EAR | Toe(s), nonspecific, missing | MISS T0E |
| Eye, left | MISS L EYE | Tongue | MISS T0NG |
| Finger(s), left hand | MISS L FGR | Tonsils | MISS T0NSL |
| Finger joint(s), left hand | MISS L FJT | Uterus | MISS UTRUS |
| Foot, left | MISS L FT | Missing Vertebra(e),nonspecific | MISS VRT |
| Hand, left | MISS L HND | | |
| Kidney, left | MISS L KID | Ovaries | MISS 0VARS |
| Leg, left | MISS L LEG | Ovary, nonspecific, missing | MISS 0VARY |
| Testis, left | MISS L TES | | |
| Toes(s), left foot | MISS L T0E | Mute (To be used if person is mute but not deaf.) | MUTE |
| Missing Lumbar Vertebra(e) | MISS L VRT | | |
| Breast, left | MISS LBRST | Abdomen | M0LE ABD0M |
| Leg, nonspecific, missing | MISS LEG | Ankle, nonspecific | M0LE ANKL |
| Arm, lower left | MISS LLARM | Arm, nonspecific, mole | M0LE ARM |
| Leg, lower left | MISS LLLEG | Back | M0LE BACK |
| Lung, left | MISS LLUNG | Breast, nonspecific | M0LE BRST |
| Arm, lower right | MISS LRARM | Buttocks, nonspecific | M0LE BUTTK |
| Leg, lower right | MISS LRLEG | Calf, nonspecific, mole | M0LE CALF |
| Larynx | MISS LRYNX | Chest | M0LE CHEST |
| Lung, nonspecific, missing | MISS LUNG | Chin | M0LE CHIN |
| | | Cheek (face), nonspecific | M0LE CHK |
| Ovary, left | MISS L0VAR | Ear, nonspecific | M0LE EAR |
| Nose | MISS N0SE | Elbow, nonspecific, mole | M0LE ELB0W |
| Pancreas | MISS PANCR | Eye, nonspecific, mole | M0LE EYE |
| Missing Penis | MISS PENIS | Forearm, nonspecific, mole | M0LE F ARM |
| Prostate Gland | MISS PR0ST | | |
| Arm, right | MISS R ARM | Face, mole | M0LE FACE |
| Ear, right | MISS R EAR | Finger, nonspecific | M0LE FGR |
| Eye, right | MISS R EYE | Forehead | M0LE FHD |
| Finger(s), right hand | MISS R FGR | Foot, nonspecific | M0LE F00T |
| Finger joint(s), right hand | MISS R FJT | Groin area | M0LE GR0IN |
| Foot, right | MISS R FT | Hand | M0LE HAND |
| Hand, right | MISS R HND | Head, nonspecific | M0LE HEAD |
| | | Hip, nonspecific | M0LE HIP |
| | | Knee, nonspecific | M0LE KNEE |

| | | | |
|---|---|---|---|
| Ankle, left | M0LE L ANK | Toe(s), nonspecific, mole | M0LE T0E |
| Arm, left | M0LE L ARM | Lip, right | M0LE U LIP |
| Buttock, left | M0LE L BUT | Upper Left Arm, mole | M0LE UL ARM |
| Left Calf, mole | M0LE L CALF | Upper Right Arm, mole | M0LE UR ARM |
| Cheek (face), left | M0LE L CHK | Wrist, nonspecific, mole | M0LE WRS |
| Ear, left | M0LE L EAR | Ankle, nonspecific, needle mark | NM ANKL |
| Left Elbow, mole | M0LE L ELB | Arm, nonspecific, needle mark | NM ARM |
| Eyebrow, left/left eye area | M0LE L EYE | Buttock, nonspecific, needle mark | NM BUTTK |
| Finger(s), left hand | M0LE L FGR | Calf, nonspecific, needle mark | NM CALF |
| Foot, left | M0LE L FT | Elbow, nonspecific, needle mark | NM ELB0W |
| Hip, left | M0LE L HIP | Finger(s), nonspecific, needle mark | NM FGR |
| Hand, left | M0LE L HND | Foot, nonspecific, needle mark | NM F00T |
| Knee, left | M0LE L KNE | Groin, nonspecific, needle mark | NM GR0IN |
| Leg, left | M0LE L LEG | Hand, nonspecific, needle mark | NM HAND |
| Lip, lower | M0LE L LIP | Hip, nonspecific, needle mark | NM HIP |
| Shoulder, left | M0LE L SHD | Knee, nonspecific, needle mark | NM KNEE |
| Thigh, left | M0LE L THG | Left Ankle, needle mark | NM L ANKL |
| Left Toe, mole | M0LE L T0E | Arm, left | NM L ARM |
| Wrist, left | M0LE L WRS | Buttock, left | NM L BUTTK |
| Breast, left | M0LE LBRST | Left Calf, needle mark | NM L CALF |
| Leg, nonspecific | M0LE LEG | Left Elbow, needle mark | NM L ELB |
| Left forearm, mole | M0LE LF ARM | Finger(s), left hand | NM L FGR |
| Lip, nonspecific | M0LE LIP | Foot, left | NM L F00T |
| Neck | M0LE NECK | Left Hip, needle mark | NM L HIP |
| Nose | M0LE N0SE | Hand, left | NM L HND |
| Penis | M0LE PENIS | Left Knee, needle mark | NM L KNE |
| Ankle, right | M0LE R ANK | Leg, left | NM L LEG |
| Arm, right | M0LE R ARM | Left Shoulder, needle mark | NM L SHLD |
| Buttock, right | M0LE R BUT | Thigh, left | NM L THIGH |
| Right Calf, mole | M0LE R CALF | Left Toe, needle mark | NM L T0E |
| Cheek (face), right | M0LE R CHK | Wrist, left | NM L WRIST |
| Ear, right | M0LE R EAR | Leg, nonspecific, needle mark | NM LEG |
| Right Elbow, mole | M0LE R ELB | Lower Left Arm, needle mark | NM LL ARM |
| Eyebrow, right/right eye area | M0LE R EYE | Lower Right Arm, needle mark | NM LR ARM |
| Finger(s), right hand | M0LE R FGR | | |
| Foot, right | M0LE R FT | Penis, needle mark | NM PENIS |
| Hip, right | M0LE R HIP | Right Ankle, needle mark | NM R ANKL |
| Hand, right | M0LE R HND | | |
| Knee, right | M0LE R KNE | | |
| Leg, right | M0LE R LEG | | |
| Shoulder, right | M0LE R SHD | | |
| Thigh, right | M0LE R THG | | |
| Right Toe, mole | M0LE R T0E | | |
| Wrist, right | M0LE R WRS | | |
| Breast, right | M0LE RBRST | | |
| Right forearm, mole | M0LE RF ARM | | |
| Shoulder, nonspecific | M0LE SHLD | | |
| Thigh, nonspecific | M0LE THGH | | |

| | | | |
|---|---|---|---|
| Buttock, right | NM R BUTTK | Pockmarks | P0CKMARKS |
| Right Calf, needle mark | NM R CALF | Abdomen | RTAT ABDM |
| Right Elbow, needle mark | NM R ELB | Ankle, nonspecific | RTAT ANKL |
| Finger(s), right hand | NM R FGR | Arm, nonspecific | RTAT ARM |
| Foot, right | NM R F00T | Back | RTAT BACK |
| Right Hip, needle mark | NM R HIP | Breast, nonspecific | RTAT BRST |
| Hand, right | NM R HND | Buttocks, nonspecific | RTAT BUTTK |
| Right Knee, needle mark | NM R KNE | Calf, nonspecific | RTAT CALF |
| Leg, right | NM R LEG | Cheek (face), nonspecific | RTAT CHEEK |
| Right Shoulder, needle mark | NM R SHLD | Chest | RTAT CHEST |
| Thigh, right | NM R THIGH | Chin | RTAT CHIN |
| Right Toe, needle mark | NM R T0E | Ear, nonspecific | RTAT EAR |
| Wrist, right | NM R WRIST | Elbow, nonspecific | RTAT ELB0W |
| Shoulder, nonspecific, needle mark | NM SHLD | Eye, nonspecific, remove tattoo | RTAT EYE |
| Thigh, nonspecific, needle mark | NM THIGH | Face, nonspecific (Use the MIS field to further describe location) | RTAT FACE |
| Toe(s), nonspecific, needle mark | NM T0E | Forearm, nonspecific | RTAT FARM |
| Upper Left Arm, needle mark | NM UL ARM | Forehead | RTAT FHD |
| | | Full body | RTAT FLB0D |
| Upper Right Arm, needle mark | NM UR ARM | Finger, nonspecific | RTAT FNGR |
| | | Foot, nonspecific | RTAT F00T |
| Wrist, nonspecific, needle mark | NM WRIST | Groin Area | RTAT GR0IN |
| | | Hand, nonspecific | RTAT HAND |
| Pierced abdomen | PRCD ABDMN | Head, nonspecific (Use the MIS fieldo further describe location) | RTAT HEAD |
| Pierced back | PRCD BACK | | |
| Pierced ear, one nonspecific | PRCD EAR | | |
| Pierced ears | PRCD EARS | Hip, nonspecific | RTAT HIP |
| Pierced eyebrow, nonspecific | PRCD EYE | Knee, nonspecific | RTAT KNEE |
| | | Arm, left | RTAT L ARM |
| Pierced genitalia | PRCD GNTLS | Cheek (face), left | RTAT L CHK |
| Pierced left ear | PRCD L EAR | Ear, left | RTAT L EAR |
| Pierced left eyebrow | PRCD L EYE | Elbow, left | RTAT L ELB |
| Pierced nipple, left | PRCD L NIP | Left Eye, remove tattoo | RTAT L EYE |
| Pierced lip, nonspecific | PRCD LIP | Finger(s), left hand | RTAT L FGR |
| Pierced lip, lower | PRCD LLIP | Hip, left | RTAT L HIP |
| Pierced nipple, nonspecific | PRCD NIPPL | Hand, left | RTAT L HND |
| | | Leg, left | RTAT L LEG |
| Pierced nose | PRCD N0SE | Left Toe, remove tattoo | RTAT L T0E |
| Pierced right ear | PRCD R EAR | Ankle, left | RTAT LANKL |
| Pierced right eyebrow | PRCD R EYE | Breast, left | RTAT LBRST |
| Pierced nipple, right | PRCD R NIP | Buttocks, left | RTAT LBUTK |
| Pierced tongue | PRCD T0NGU | Calf, left | RTAT LCALF |
| Pierced lip, upper | PRCD ULIP | Leg, nonspecific | RTAT LEG |
| Jaw, nonspecific, protruding | PR0T JAW | Forearm, left | RTAT LFARM |
| | | Foot, left | RTAT LF00T |
| Protruding lower jaw | PR0T L JAW | Lip, nonspecific | RTAT LIP |

| | |
|---|---|
| Shoulder, left | RTAT LSHLD |
| Thigh, left | RTAT LTHGH |
| Lip, lower | RTAT LWLIP |
| Wrist, left | RTAT LWRS |
| Neck | RTAT NECK |
| Nose | RTAT N0SE |
| Penis | RTAT PENIS |
| Arm, right (Use the MIS field to further describe location) | RTAT R ARM |
| Cheek (face), right | RTAT R CHK |
| Ear, right | RTAT R EAR |
| Elbow, right | RTAT R ELB |
| Right Eye, remove tattoo | RTAT R EYE |
| Finger(s), right hand | RTAT R FGR |
| Hip, right | RTAT R HIP |
| Hand, right | RTAT R HND |
| Leg, right (Use the MIS field tourther describe location) | RTAT R LEG |
| Right Toe, remove tattoo | RTAT R T0E |
| Angle, right | RTAT RANKL |
| Breast, right | RTAT RBRST |
| Buttocks, right | RTAT RBUTK |
| Calf, right | RTAT RCALF |
| Forearm, right | RTAT RFARM |
| Foot, right | RTAT RF00T |
| Knee, right | RTAT RKNEE |
| Shoulder, right | RTAT RSHLD |
| Thigh, right | RTAT RTHGH |
| Wrist, right | RTAT RWRS |
| Shoulder, nonspecific | RTAT SHLD |
| Thigh, nonspecific | RTAT THGH |
| Toe(s), nonspecific, remove tattoo | RTAT T0E |
| Arm, left upper | RTAT ULARM |
| Lip, upper | RTAT UPLIP |
| Arm, right upper | RTAT URARM |
| Wrist, nonspecific | RTAT WRS |
| Abdomen | SC ABD0M |
| Ankle, nonspecific | SC ANKL |
| Arm, nonspecific | SC ARM |
| Back | SC BACK |
| Breast, nonspecific | SC BREAST |
| Buttocks, nonspecific | SC BUTTK |
| Calf, nonspecific | SC CALF |
| Chest | SC CHEST |
| Chin | SC CHIN |
| Cheek, nonspecific | SC CHK |
| Ear, nonspecific | SC EAR |

| | |
|---|---|
| Elbow, nonspecific | SC ELB0W |
| Eyebrow, nonspecific | SC EYE |
| Forearm, nonspecific | SC F ARM |
| Face, nonspecific (use MIS field to further describe location) | SC FACE |
| Finger, nonspecific | SC FGR |
| Forehead | SC FHD |
| Foot, nonspecific | SC F00T |
| Groin area | SC GR0IN |
| Hand, nonspecific | SC HAND |
| Head, nonspecific (use MIS field to further describe location) | SC HEAD |
| Hip, nonspecific | SC HIP |
| Knee, nonspecific | SC KNEE |
| Ankle, left | SC L ANKL |
| Arm, left, nonspecific | SC L ARM |
| Breast, left | SC L BRST |
| Buttocks, left | SC L BUTTK |
| Calf, left | SC L CALF |
| Cheek, left | SC L CHK |
| Ear, left | SC L EAR |
| Elbow, left | SC L ELB |
| Eyebrow, left/left eye area | SC L EYE |
| Finger(s), left hand | SC L FGR |
| Foot, left | SC L FT |
| Hip, left | SC L HIP |
| Hand, left | SC L HND |
| Knee, left | SC L KNEE |
| Leg, left | SC L LEG |
| Shoulder, left | SC L SHLD |
| Thigh, left | SC L THGH |
| Left Toe, scar | SC L T0E |
| Wrist, left | SC L WRIST |
| Leg, nonspecific | SC LEG |
| Forearm, left | SC LF ARM |
| Lip, nonspecific | SC LIP |
| Lip, lower | SC L0W LIP |
| Neck | SC NECK |
| Nose | SC N0SE |
| Penis | SC PENIS |
| Ankle, right | SC R ANKL |
| Arm, right, nonspecific | SC R ARM |
| Breast, right | SC R BRST |
| Buttocks, right | SC R BUTTK |
| Calf, right | SC R CALF |
| Cheek, right | SC R CHK |
| Ear, right | SC R EAR |
| Elbow, right | SC R ELB |

| | |
|---|---|
| Eyebrow, right/right eye area | SC R EYE |
| Finger(s), right hand | SC R FGR |
| Foot, right | SC R FT |
| Hip, right | SC R HIP |
| Hand, right | SC R HND |
| Knee, right | SC R KNEE |
| Leg, right | SC R LEG |
| Shoulder, right | SC R SHLD |
| Thigh, right | SC R THGH |
| Right Toe, scar | SC R T0E |
| Wrist, right | SC R WRIST |
| Forearm, right | SC RF ARM |
| Shoulder, nonspecific | SC SHLD |
| Thigh, nonspecific | SC THGH |
| Toe(s), nonspecific, scar | SC T0E |
| Arm, left upper | SC UL ARM |
| Lip, upper | SC UP LIP |
| Arm, right upper | SC UR ARM |
| Wrist, nonspecific | SC WRIST |
| Shorter left leg | SHRT L LEG |
| Leg, nonspecific, short | SHRT LEG |
| Shorter right leg | SHRT R LEG |
| Shunt, arterial vascular | SHUNT ART |
| Shunt, cerebral ventricule | SHUNT CERB |
| Skull plate | SKL PLATE |
| Silver tooth | SLVR T00TH |
| Staples | STAPLES |
| Stutters | STUTTERS |
| Abdomen | TAT ABD0M |
| Ankle, nonspecific | TAT ANKL |
| Arm, nonspecific | TAT ARM |
| Back | TAT BACK |
| Breast | TAT BREAST |
| Buttocks | TAT BUTTK |
| Calf, nonspecific | TAT CALF |
| Cheek (face), nonspecific | TAT CHEEK |
| Chest | TAT CHEST |
| Chin | TAT CHIN |
| Ear, nonspecific | TAT EAR |
| Elbow, nonspecific | TAT ELB0W |
| Eye, nonspecific, tattoo | TAT EYE |
| Face, nonspecific (use MIS field to further describe location) | TAT FACE |
| Forearm, nonspecific | TAT FARM |
| Forehead | TAT FHD |

| | |
|---|---|
| Full Body (Use only when the entire body - arms, legs, chest, and back are covered with tattoos.) | TAT FLB0DY |
| Finger, nonspecific | TAT FNGR |
| Foot, nonspecific | TAT F00T |
| Groin area | TAT GR0IN |
| Hand, nonspecific | TAT HAND |
| Head, nonspecific (use MIS field to further describe location) | TAT HEAD |
| Hip, nonspecific | TAT HIP |
| Knee, nonspecific | TAT KNEE |
| Ankle, left | TAT L ANKL |
| Arm, left | TAT L ARM |
| Breast, left | TAT L BRST |
| Buttock, left | TAT L BUTK |
| Calf, left | TAT L CALF |
| Cheek (face), left | TAT L CHK |
| Ear, left | TAT L EAR |
| Left Eye, tattoo | TAT L EYE |
| Finger(s), left hand | TAT L FGR |
| Foot, left | TAT L F00T |
| Hip, left | TAT L HIP |
| Hand, left | TAT L HND |
| Knee, left | TAT L KNEE |
| Leg, left, nonspecific | TAT L LEG |
| Shoulder, left | TAT L SHLD |
| Thigh, left | TAT L THGH |
| Left Toe, tattoo | TAT L T0E |
| Wrist, left | TAT L WRS |
| Leg, nonspecific | TAT LEG |
| Elbow, left | TAT LELB0W |
| Forearm, left | TAT LF ARM |
| Lip, nonspecific | TAT LIP |
| Lip, lower | TAT LW LIP |
| Neck | TAT NECK |
| Nose | TAT N0SE |
| Penis | TAT PENIS |
| Ankle, right | TAT R ANKL |
| Arm, right | TAT R ARM |
| Breast, right | TAT R BRST |
| Buttock, right | TAT R BUTK |
| Calf, right | TAT R CALF |
| Cheek (face), right | TAT R CHK |
| Ear, right | TAT R EAR |
| Right Eye, tattoo | TAT R EYE |
| Finger(s), right hand | TAT R FGR |

| | | | |
|---|---|---|---|
| Foot, right | TAT R F00T | Other therapeutic medications not listed above, identify in the MIS Field. | TD 0THER |
| Hip, right | TAT R HIP | Transsexual (Miscellaneous field should indicate what the individual was at birth and what they are at the time the record is entered into NCIC.) | TRANSSXL |
| Hand, right | TAT R HND | | |
| Knee, right | TAT R KNEE | | |
| Leg, right, nonspecific | TAT R LEG | | |
| Shoulder, right | TAT R SHLD | | |
| Thigh, right | TAT R THGH | | |
| Right Toe, tattoo | TAT R T0E | | |
| Wrist, right | TAT R WRS | | |
| Elbow, right | TAT RELB0W | | |
| Forearm, right | TAT RF ARM | | |
| Shoulder, nonspecific | TAT SHLD | Transvestite | TRANSVST |
| Thigh, nonspecific | TAT THGH | Tube in left ear | TUBE L EAR |
| Toe(s), nonspecific, tattoo | TAT T0E | Tube in right ear | TUBE R EAR |
| Arm, left upper | TAT UL ARM | Vascular prosthesis | VASC PR0TH |
| Lip, upper | TAT UP LIP | Wheelchair | WHEELCHAIR |
| Arm, right upper | TAT UR ARM | Wire sutures | WIRE SUTUR |
| Wrist, nonspecific | TAT WRS | Orthopedic nail or pin | 0RTH NAIL |
| Anticonvulsants (seizure medicines - includes: Dilantin Mysoline, Phenobarbital, etc.) | TD AC0NVUL | Orthopedic plate | 0RTH PLATE |
| | | Orthopedic screw | 0RTH SCREW |
| Antidepressants (mood-lifters - (Mood lifters - includes: Amitriptylene, Elavil, Norpramine, Prozac, Triavil, Zoloft, etc.) | TD ADEPRES | | |
| Analgesics (pain relievers -includes: Darvon, Acetominophen, Aspirin, etc.) | TD ANALGES | | |
| Antibiotics | TD ANTBTCS | | |
| Anti-Inflammatory Medication | TD ANTINFL | | |
| Bronchial Dilators (Includes inhalers) | TD BRNCHDL | | |
| Cardiac (heart medications - includes: Digitalis, Digoxin, etc.) | TD CARDIAC | | |
| Hypnotics (sleeping aides -includes: Barbiturates, Chloral Hydrate, Glutethemide, etc.) | TD HYPN0TI | | |
| Insulin | TD INSULIN | | |
| Ritalin | TD RITALIN | | |
| Tranquilizers (includes: Valium, Thorazine, Stellazine, etc.) | TD TRANQUI | | |

## Annex E Best Practices for Facial Capture

## Informative

**INTRODUCTION**

This "Best Practice Recommendation" is based upon work originating at a Mugshot and Facial Image Workshop held at NIST in 1995.  The original recommendation document was incorporated as Annex H in the 2007 / 2008 version of the ANSI/NIST-ITL standard, supplemented by Annex I, which extended the recommendations further, as well as Annex J, which dealt with Face-Pose values.  This document combines the three annexes of the 2007 / 2008 standard and includes new information, which in no manner contradicts earlier guidance.

It contains a suggested set of procedures and equipment specifications for organizations considering the purchase of new systems or the upgrade of current systems.   The recommendation is not designed to render current and legacy mugshot collections unacceptable.  Rather, it is intended as a means of establishing or improving interoperability between mugshot systems.

This recommendation reflects a minimum set of common denominators. The provisions of this recommendation are keyed to the quality aspects associated with the unaltered captured mugshot image.  For new mugshot images being captured, the specifications contained in this recommendation are equally applicable to real-time electronic capture of mugshots as well as the electronic conversion of photographic images. For conversion of legacy files of photographs, the provisions of this recommendation are applicable.

This Annex consists of a set of clauses describing requirements and recommendations for the capture of facial images.   These clauses can be categorized into four types of requirements: digital, photographic, subject and scene, and data handling.

Note that the provisions of this apply to all images captured in compliance with SAP 30 or above, unless otherwise noted . See **Clause 7.13.1 Subject acquisition profile for face.**

# DIGITAL REQUIREMENTS

**Pixel aspect ratio**

Digital cameras and scanners used to capture facial images shall use square pixels with a pixel aspect ratio of 1:1

**Image aspect ratio**

For SAPs 30 and 32, the aspect ratio shall be 4:5 (480x600pixels).  For SAP 40 and above, the aspect ratio shall be 3:4, which corresponds to commonly used format sizes such as 600 x 800, 768x1024, etc., allowing a COTS digital camera to be used for capture.  Images from some types of camera with a different aspect ratio shall need to be cropped.

**No interlacing**

Interlaced video frames shall not be used in the capture of a facial image.

**No digital zoom**

The use of digital zoom (interpolation) to achieve specified resolution associated with Subject Acquisition Profiles shall not be used in the capture of a facial image.

**Minimum number of pixels**

The minimum number of pixels in an electronic digital image shall be 480 pixels in the horizontal direction by 600 pixels in the vertical direction.  It should be noted that the image quality of the captured mugshots and facial images may be improved as the number of pixels in both directions are increased.  However, as images are captured with an increased number of pixels, the 4:5 (SAPs 30/32) and 3:4 (SAP 40 and above) (Width:Height) aspect ratio shall be maintained.

Two considerations must be noted regarding this aspect of the recommendation. First, the normal orientation of many available cameras is the landscape format, which specifies a greater number of pixels in the horizontal than in the vertical direction. Unless these cameras capture at least 600 pixels in the vertical direction, it may be necessary to rotate the camera 90 degrees.  Second, the 480x600 capture format exceeds the VGA display format of 640x480. Therefore, at a minimum, an SVGA specification of 800x600 pixels shall be required to display the facial image. The image shall occupy less than the total number of available horizontal pixels.

# PHOTOGRAPHIC REQUIREMENTS

## Depth of field

The subject's captured facial image shall always be in focus from the nose to the ears. Although this may result in the background behind the subject being out of focus, this is not a problem. It is recommended that auto-focus on the central part of face be used with digital camera photography. For optimum quality of the captured mugshot, the f- stop of the lens should be set at two f-stops below the maximum aperture opening when possible.

## Subject lighting

Lighting shall be equally distributed on the face. There shall be no significant direction of the light from the point of view of the photographer. Subject illumination shall be accomplished using a minimum of three (3) point-balanced illumination sources. Appropriate diffusion techniques shall be employed and lights positioned to minimize shadows, and to eliminate hot spots on the facial image. These hot spots usually appear on reflective areas such as cheeks and foreheads. Proper lighting shall contribute to the uniformity of illumination of the background described in the exposure requirement.

Although a minimum of three photo lights is required for illuminating the subject's face, two of these lights should be sufficient for some operational environments. Use of a third light as a backlight generally requires about two feet of additional floor space behind the subject, which may not be available in all environments.

The region of the face, from the crown to the base of the chin, and from ear-to-ear, shall be clearly visible and free of shadows. In particular, there shall be no dark shadows in the eye-sockets due to the brow and the iris and pupil of the eyes shall be clearly visible.

## Background and lighting

The subject whose image is being captured shall be positioned in front of a background that is 18% gray with a plain smooth flat surface[291]. A Kodak or other neutral gray card or densitometer shall be used to verify this 18% gray reflectance requirement. The boundary between the head and the background should be clearly identifiable about the entire subject (very large volume hair excepted). There should be no shadows visible on the background behind the face image. Proper lighting shall contribute to the uniformity of illumination of the background.

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[291] An example of a paint formula that will approximate an 18% gray (on matte surface) is one quart Olympic Premium Interior Latex Eggshell, Base 3 - 72403, 101-1Y31.5, 109-8.5, or one quart Benjamin Moore & Co. Premium Interior Latex Flat Finish Wall Satin, Medium Base 215 2B, Formula: OY-8½ RX-3/4 BK-21 GY-4 WH-10, Area/Tint Code: B.

Ensure that the background completely fills the image frame behind the subject. If possible, avoid the presence of visible shadows and other objects in the background, such as a clock face.

**Exposure calibration**

The exposure shall be keyed to the background. Several areas of the recorded 18% gray background shall be used to verify the proper exposure. The averages of the 8-bit Red, Green, and Blue (RGB) components within each area shall be calculated. Each of the RGB means shall fall between 105 and 125 with a standard deviation of ±10. Furthermore, for every area examined, the maximum difference between the means of any two of the RGB components shall not exceed 10.

**Exposure**

When capturing images using digital cameras, the exposure should be such that the image is as bright as possible without introducing any clipping of the highlights. With most digital cameras, this can easily be checked by examining the histogram[292] associated with the image. Most modern digital cameras have sophisticated metering systems that should ensure that a properly exposed image is always captured once the camera and lights have been correctly set up.

**No saturation**

For each patch of skin on the person's face, the gradations in textures shall be clearly visible. In this sense, there shall be no saturation (over or under exposure) on the face.

**No unnatural color or "red-eye"**

Unnaturally colored lighting (e.g. yellow, red) is not allowed. Care shall be taken to correct the "white balance" of image capture devices. The lighting shall produce a face image with natural looking flesh tones when viewed in typical examination environments. "Red-eye" is not acceptable.

**No color or grayscale enhancement**

A process that overexposes or underexposes a color or grayscale image for purposes of beauty enhancement or artistic pleasure is not allowed. The full spectrum shall be represented on the face image where appropriate. Teeth and whites of eyes shall be clearly

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[292] http://www.photographyreview.com/histogramguidecrx.aspx

light or white (when appropriate) and dark hair or features (when appropriate) shall be clearly dark.

**Distortion and angle of view**

Unnatural radial distortion of the camera lens, resulting in a diagonal angle of view of approximately 20 to 28 degrees, shall not be allowed.

Fish eye effect, a type of distortion where central objects of the image erroneously appear closer than those at the edge, typically resulting in what appear to be unusually large noses in the image, is not allowed. While some distortion is usually present during portrait photography, that distortion should not be noticeable by human examination.

For a typical photo capture system with a subject 1.5 to 2.5 meters from the camera, the focal length of the camera lens should be that of a medium telephoto lens. For 35 mm photography, this means that the focal length should be between 90 mm and 130 mm. For other negative formats/sensors, the recommended focal length is 2 to 3 times the diagonal of the negative/sensor.

**Allowed color Space**

Captured electronic color facial images are required.  Digital images shall be represented as 24-bit RGB pixels. For every pixel, eight (8) bits shall be used to represent each of the Red, Green, and Blue components.  The RGB color space is the basis for other color spaces including the Y, Cb, Cr  and YUV. Additional color management techniques are available from the International Color Consortium.  Information regarding these techniques can be downloaded from the following URL: http://www.color.org/.

A full color image shall be captured. To ensure that color images exchanged between differing systems can be correctly displayed or printed, images shall be converted to the device-independent color space, sRGB.

**SUBJECT & SCENE REQUIREMENTS**

### *Pose*

The full-face or frontal pose is the most commonly used pose in photo lineups and shall always be captured. This pose is in addition to profiles or intermediate angled poses captured to acquire perspective and other information.

### *Subject position*

It is important that no shadows are cast onto the background from the subject's head. One way to achieve this is by positioning the subject 1-2 feet away from the background, and/or using an additional light source to illuminate the background.

### *Centering*

The full-frontal face pose shall be positioned to satisfy all of the following conditions[293]:

### *The "Head and Shoulders" photo composition*

The composition consists of a subject's head, partial shoulders, and plain background. For a frontal-facing pose, the width of the subject's head shall occupy approximately 50% of the width of the captured image. This width shall be the horizontal distance between the mid-points of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head. See **Figure 17.**

- The approximate horizontal mid-points of the mouth and of the bridge of the nose shall lie on an imaginary vertical straight line positioned at the horizontal center of the image.

- An imaginary horizontal line through the center of the subject's eyes shall be located at approximately the 55% point of the vertical distance up from the bottom edge of the captured image.

- The width of the subject's head shall occupy approximately 50% of the width of the captured image. This width shall be the horizontal distance between the mid-points

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[293] For non-frontal pose (SAP levels 40 and above) , the subject shall satisfy these conditions when the head is rotated about an axis though the head and torso from the current pose back to center (zero angles) pose.

of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head.

*The "Head Only" photo composition*

The composition consists of a subject's head, and a plain background. For a frontal- facing pose, the width of the subject's head shall occupy approximately 70% of the width of the captured image. This width shall be the horizontal distance between the midpoints of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head. A template and an example are shown in **Figure 18**. For other poses, the composition shall be rotated about an imaginary axis extending from the top of the head though the base of the neck. This composition is applied to SAP level 51.

### Head coverings

Head coverings, including hats and scarves, shall not be worn. The full face and ears must be displayed.

### Hair

When capturing frontal, profile and angled images, the subject's hair shall be moved to reveal the full face and ears. If hair covers the ears, then when possible, two photographs shall be captured – one with hair in its normal state, and one with hair pulled back behind the ears.

### Glasses and eye patches

For subjects who normally wear eyeglasses, every effort should be made to capture the mugshots with the glasses on. If significant glare in the glasses is evident in the photograph, then a second frontal mugshot image should be captured of the subject without glasses. Specification of eyeglasses in **Field 10.026: Subject facial description / SXS** is required. The wearing of eye patches is allowed only for medical reasons. In these cases, the specification of the patch, in the SXS field is required.

### Expression

The expression should be neutral (non-smiling) with both eyes open normally (i.e. not wide-open), and mouth closed. Every effort should be made to have supplied images conform with this specification. A smile with closed jaw is not recommended.

### Mouth

Mouth shall be closed.

### Subject facial description (SXS)

The Subject facial description field shall be present in the transaction when one or more of the facial attributes given by the type codes of **Field 10.026: Subject facial description / SXS** is present in the image.

### Subject hair color (SHC)

The Subject hair color **Field 10.028: Subject hair color / SHC** shall be present in the transaction. The code "UNSPECIFIED" for this field is not allowed.

### Subject eye color (SEC)

The Subject eye color **Field 10.027: Subject eye color / SEC** shall be present in the transaction. The code "UNSPECIFIED" for this field is not allowed.

### Shoulder position

Shoulder position shall be square to the camera and forward facing for frontal images. Shoulder position shall be perpendicular to the camera for profile images.

### Make-up and cleanliness

The subject's face should not be presented with heavy make-up, dirt, blood, etc.  In an operational environment where this may not be possible, best practice is to take a second (set of) photographs once the subject has been cleaned up.

### Face count

Only one face per image is allowed.

### Medical conditions

If bruising, injuries, bandages, or medical conditions exist, these shall be captured as is.

*Number of photographs*

Only Levels 50, 51and 52 records mandate multiple images. However, if the subject has accessories that occlude facial features, e.g. such as eyebrow studs, ear plugs, or rings through the nose, at least one frontal image should be captured with them and one image without. Levels 50, 51 and 52 shall include at least five photographs of the subject: (frontal, left full profile, right full profile, left half profile and right half profile).



**Figure 16 Five poses for SAP 50, 51 and 52**
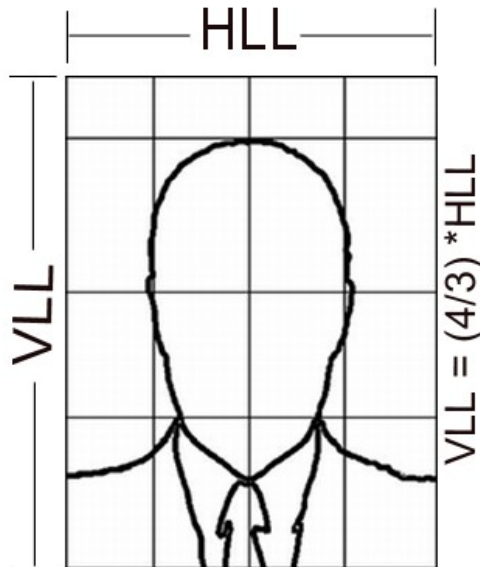


**Figure 17: A facial template and example of "Head and Shoulders" scene constraints**
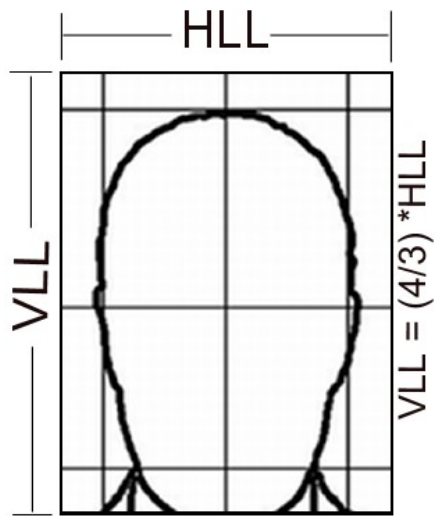
**Figure 18: Facial image template and example of "Head Only" scene constraints**

# DATA HANDLING REQUIREMENTS

## Compression algorithm

### SAP Level 30 only:

The algorithm used to compress mugshot and facial images shall conform to the JPEG Sequential Baseline mode of operation as described in *ISO/IEC 10918*. The target size for a JPEG compressed color mugshot image file shall be 25,000 to 45,000 bytes.

### SAP Levels 40 and above:

Non-frontal facial images shall be compressed using JPEG 2000, as specified in *ISO/IEC 15444*. (JPEG is not allowed)

There shall be one frontal facial image compressed using lossless JPEG 2000. If multiple frontal images are in the transaction, then one image must be compressed via lossless compression and the others can be compressed either using lossless JPEG 2000 or lossy JPEG 2000 that meets the maximum compression limits specified below. The best practice is to apply the lossless compression to the frontal image with ears visible.

### Compression ratio

The maximum compression ratio for both JPEG and JPEG 2000 of a rectangular region containing any exposed skin of the face, from crown to chin and ear to ear, shall be at most 15:1. This requirement is derived from studies of face algorithm matching at high and low resolutions. The non-facial portion of the mugshot, as well as other Type-10 records, can be compressed up to a ratio of 120:1.

For JPEG provides source code to implement compression with both ROI and fixed compression ratios. For JPEG 2000, these capabilities are built into the implementation.

For both JPEG and JPEG 2000, care must be taken to account for automatic compression by camera hardware. Multiple compression stages can damage the quality of photographic data. When possible, minimum compression (highest resolutions) should be applied at the camera level when external software performs the final (15:1 or less) compression stage.

**Table 100: Example file sizes after compression**

| Level | Minimum WxH | Uncompressed Size (RGB888) | Size @ 2:1 Lossless Compression | Size @ 15:1 compression for the entire image | Size @ 15:1 compression for the face and 120:1 for the background |
|-------|-------------|----------------------------|--------------------------------|-----------------------------------------------|-------------------------------------------------------------------|
| 30 | 480x600 | 844 KB | | 58 KB | 19.34 KB |
| 40 | 768x1024 | 2.3 MB | | 156 KB | 52.8 KB |
| 50 | 3300x4400 | 42.5MB | 14.2 MB | | |
| 51 | 2400x3200 | 22.5 MB | 7.5 MB | | |

**Table 100** provides the typical size of a single facial photograph using the compression recommendations contained in this section for levels 30  and 40 , 50 and 51.This table is based upon the image being formatted as RGB888 (8 bits per color channel per pixel).  For levels 30 and 40. Since the face width is 50% of the image width, then the area taken by the face is estimated to be 25% of the total image area. SAP levels 50 and 51 include the constraint of lossless compression for the frontal pose facial image as discussed above.

## FORMAT REQUIREMENTS (SAP LEVELS 40 AND ABOVE)

**The definition and range of pose angles**

The Yaw and Roll angles shall be measured from the full face pose position and have a range of values from -180 degrees to +180 degrees. The Pitch angle shall have a range of values from -90 degrees to +90 degrees.  The pose angle set is given by Tait-Bryan angles as shown in **Figure 19**.[294]

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[294] From http://en.wikipedia.org/wiki/Euler_angles
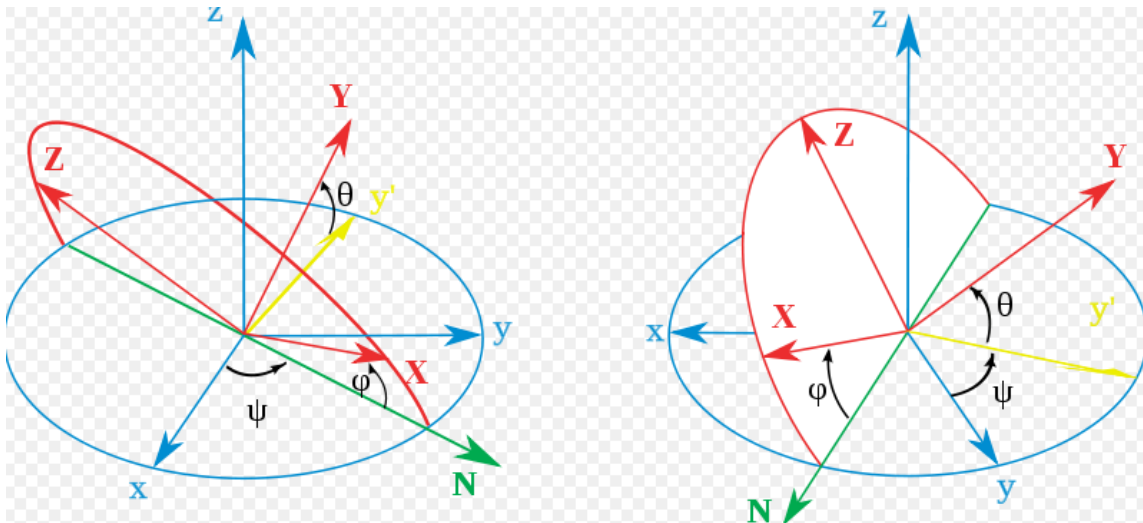
**Figure 19: Tait-Bryan angles statically defined and the  Z-X'-Y'' convention**

The angles are defined relative to the frontal view of the subject, which has angles (0, 0, 0) as shown in . Examples are shown in **Figure 20**.

*Yaw angle:* rotation about the vertical (y) axis. A positive Yaw angle is used to express the angular offset as the subject rotates from a full-face pose to their left (approaching a right profile). A negative Yaw angle is used to express the angular offset as the subject rotates from a full-face pose to their right (approaching a left profile).

*Pitch angle:* rotation about the horizontal side-to-side (x) horizontal axis.

*Roll angle:* rotation about the horizontal back to front (z) axis.
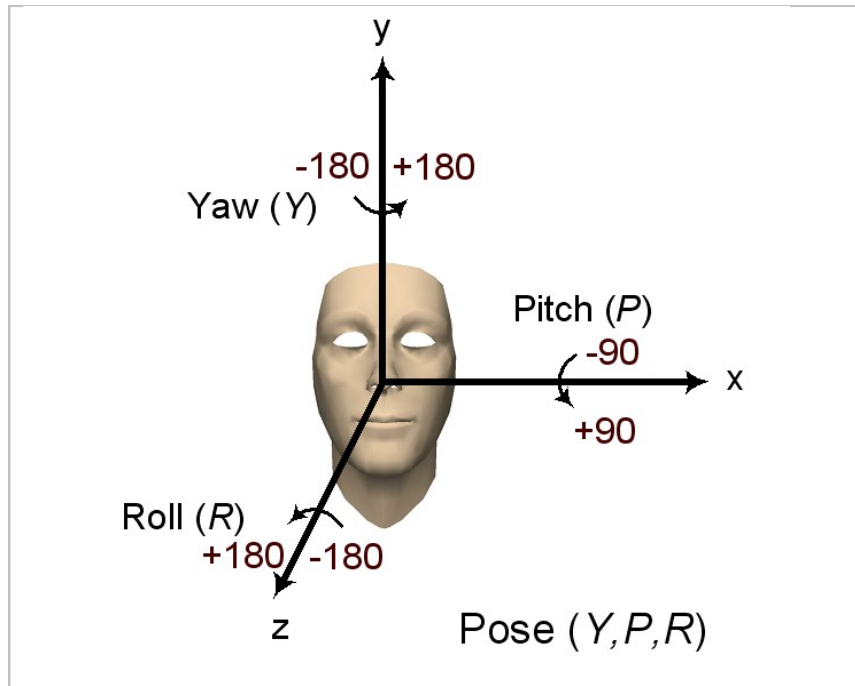
**Figure 20: Pose angle set is with respect to the frontal view of the subject**
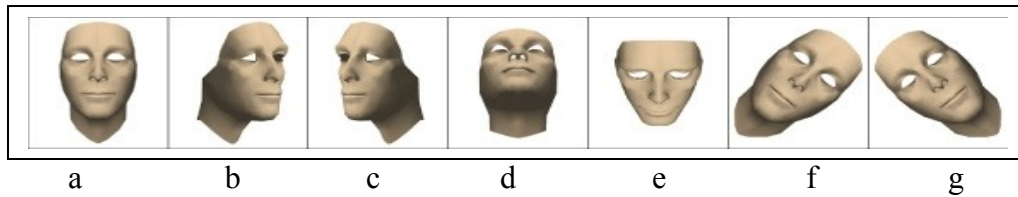


**Figure 21: Examples of pose angles and their encodings.**

The pose angles (Y, P, R) of (a) – (g) in **Figure 21** are given by (0, 0, 0), (+45, 0, 0), (-45, 0, 0), (0, -45, 0), (0, +45, 0), (0, 0, -45), and (0, 0, +45), respectively.

The uncertainty in the pose angles is given by the range 0 to 90, inclusive. It shall denote approximately a maximum value of possible deviation in the measurement of the pose. This shall correspond to a two standard deviation confidence interval.

The encoding of angles is in ASCII format, with the minus sign "-" used to denote a negative value and the plus "+" sign optionally used to denote a positive value. Pose angle uncertainty angles always are positive.

**Subject Pose (POS) and Subject pose angles (SPA)**

One of either the POS or SPA fields shall be used to denote pose angles.

The code values in **Field 10.020: Subject pose / POS** of "F", "R", and "L" can be used for images in which the Pitch and Roll angles are 0 and the Yaw angle is 0, 90, and -90 respectively. (The sign of the Yaw angle in the previous sentence corresponds to the field 10.020 where a right profile is when the subject is facing left).

**Field 10.025: Subject pose angles / SPA** can be used for the above poses and shall be used for all other angled poses. **Field 10.020: Subject pose / POS** shall then be of type code "D", for determined 3D pose, instructing the user to use **Field 10.025: Subject pose angles / SPA** as the reference for pose angles. (For example, a ¾ profile capture would require a POS field entry of "D" with the angle specified for SPA.)

A frontal view consists of a face with a Yaw, Pitch, and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (0,0,0).

A full profile view consists of a face with a Yaw pose angle of ±90 degrees, and with Pitch and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (90,0,0), subject facing left (right profile), and (-90,0,0), subject facing right (left profile). For full profile photographs, the ear facing the camera should be visible, pushing the hair back to the extent possible. For full profile images, the entire body shall be rotated with the head.

A half profile view consists of a face with a Yaw pose angle of ±45 degrees, and with Pitch and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (45,0,0), subject facing left, and (-45,0,0), subject facing right. Note that for half profile, the orientation of the head is rotated 45 degrees to half profile; the rotation of the body is recommended, but not required. Care should be taken to prevent the subject from keeping the head fixed while changing only the gaze.
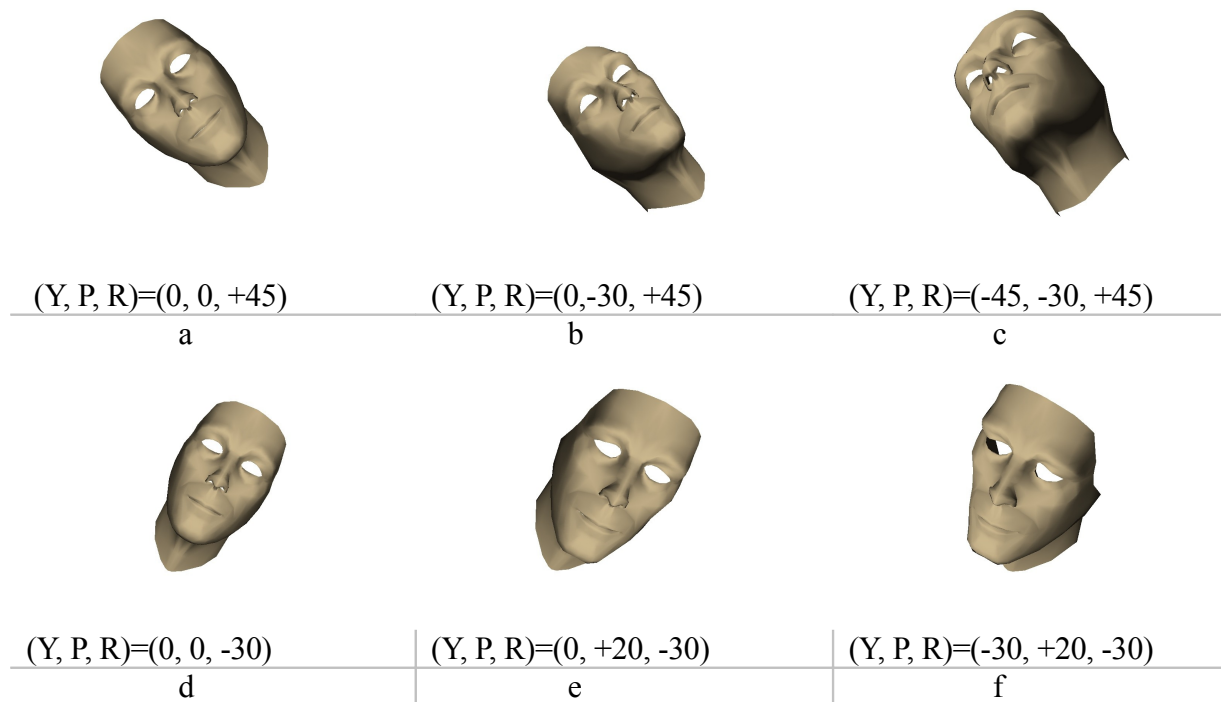
SAP 50/51/52 records may optionally include ¾ profile views, with a Yaw pose angle of ±67.5 degrees, and with Pitch and Roll angles of zero. Subject pose angle (SPA) values shall be recorded as (67.5,0,0), subject facing left, and (-67.5,0,0), subject facing right.

In all cases, the uncertainty in the Yaw pose angle determination shall be less than 5 degrees of the frontal photograph, and 10 degrees in the non-frontal photographs. The uncertainty in the Pitch and Roll angles shall be less than 5 degrees.

**The order of rotation through pose angles**

As order of the successive rotation around the different axes does matter, the encoded rotation angle shall correspond to an order of execution starting from the frontal view. This order shall be given by Roll (about the front axis), then Pitch (about the horizontal axis) and finally Yaw (about the vertical axis). The (first executed) Roll transformation shall therefore always be in the image (x, y) plane. Examples are shown in **Figure 22**.

From the point of view of executing a transformation from the observed view to a frontal view, the transformation order shall therefore be Yaw, Pitch, and then Roll. The encoded angle is from the frontal view to the observed view.



| (Y, P, R)=(0, 0, +45) | (Y, P, R)=(0,-30, +45) | (Y, P, R)=(-45, -30, +45) |
|:---:|:---:|:---:|
| a | b | c |

| (Y, P, R)=(0, 0, -30) | (Y, P, R)=(0, +20, -30) | (Y, P, R)=(-30, +20, -30) |
|:---:|:---:|:---:|
| d | e | f |

**Figure 22: Examples of the order of rotation**

The pose angles have an origin of coordinate system at the nose tip. Figures (a)-(c) show three successive rotation steps to achieve the pose angles (Y, P, R) of (-45, -30, +45). Figures (d)-(f) show three successive rotation steps to achieve the pose angles (-30, +20, -30).

**Annex F CDEFFS Detailed Description**

**Informative**

The CDEFFS Best Practices Document for Extended Feature Set Markups (Fields 9.300-9.400) is included in this standard.  It is available at
http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

It is an integral part of this version of the standard and is not considered to be an external reference.

## Annex G Bibliography

## Informative

The following bibliography includes those documents not listed as normative references in **Clause 3**.

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http://www.niem.gov/Techniques_for_Building_and_Extending_NIEM.pdf

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[295] All ISO documents available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.